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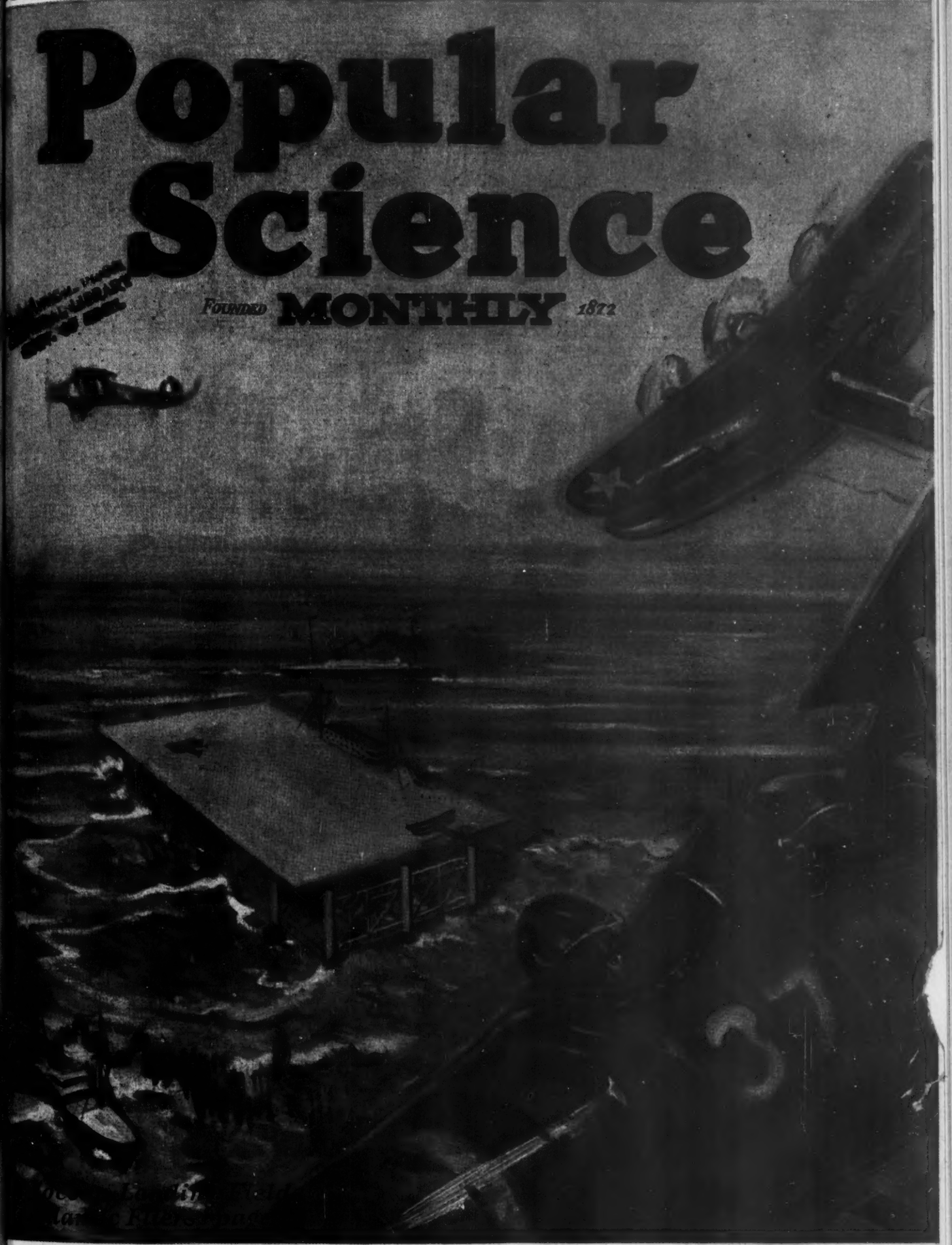

JESS HAWLEY TELLS WHAT MAKES A GOOD FOOTBALL TEAM—page 9

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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
October, 1926

A Famous Coach Discloses Some

FOOTBALL SECRETS

How a light team, taught to think and act in unison, can outplay heavier opponents through the rhythm of its movements—Some effective plays explained

By Jess B. Hawley

RHYTHM, more than anything else, is the factor responsible for such success as I have had as a football coach. Its proper application in team play is the foundation of all successful football. The coach who succeeds in instilling a sense of rhythm into his squad has more than half won his coaching battle.

Practically every successful physical effort is rhythmic, from the swing of the blacksmith's sledge to the movements of varsity oarsmen. There can be no grace of motion without rhythm, and there can be no muscular coördination without graceful motion. It doesn't matter what sort of athlete you visualize, whether the aesthetic dancer, the boxer, the golfer, the swimmer, the baseball pitcher, the pole vaulter, the tennis player, the skater, or the fleet halfback on a football team; rhythm of motion is inseparable from their achievements. The slow motion camera discloses the rhythm beyond question.

Timed unison in thinking and acting gives eleven eager men on a football team an almost irresistible advantage over another eleven that has not learned to coördinate the actions of individuals into team rhythm. It is one of the most essential qualities of a successful football team, both as an offensive and as a defensive measure. I have proved this, time and again, during my years of coaching at Iowa and at Dartmouth.

It is an engineering fact—and an obvious one—that eleven light men, timing their motions with an exactness that enables the eleven to hit the opposing line as one man, can smash through much heavier opponents with an ease that would be utterly impossible if the shock of attack were untimed, unsynchronized, without rhythm.

Of course the heavier the rhythmical team the greater the shock of attack. The speed of the rhythm is an important secret of success. It is easy to demonstrate that an object weighing 200 pounds can be much further deflected by a man weighing 150 after a run of fifty yards in six seconds than by a man who weighs 200 pounds, but who takes twelve seconds to reach the same object from the same starting point.

You can prove that for yourself rather easily by raising your foot to a certain height and letting it drop to the floor in definite rhythm, then cut the time of the rhythm in half and see how much more power there is in the stroke. There has been no change in weight, no change in distance from the floor; only a change in time of rhythm.

Possibly the best example of the value of rhythm in football I can cite is a play made by Dartmouth in the Chicago game last year. Dartmouth kicked off to Chicago. Our ends, of course, went down with the ball. A Chicago player tried for it, but missed. The ball struck his headgear and bounded toward Sage, of Dartmouth. Now remember, every Dartmouth player was acting in timed unison —rhythm.

SAGE saw the break, knew that if he broke rhythm and tried for it, he probably would recover the ball for Dartmouth, but he knew also that the Dartmouth line was three and four strides behind him, and that Captain Parker was in unison of movement with him. He would throw Parker's playing off if he broke unison. By count, Sage continued his play, which was to get his man out of the way for Parker, so the latter could get the ball and get away with it.

Sage did just that. Rather than break the perfect team rhythm, Sage passed up an opportunity to grandstand. He undoubtedly could have recovered the ball, and just possibly might not have been downed in his tracks. But he knew, without once turning his head to see, that Parker was in rhythm and that Parker would be on the ball at the exact instant Sage was blocking the Chicago player, while the Dartmouth line was getting into action.

The result was that Parker ran thirty yards for a touchdown.

But, before going more definitely into an analysis of rhythm, I think it proper in any discussion concerning the creation of an outstanding college football eleven

Can Dartmouth Repeat?

NO FOOTBALL coach in the country is being more closely watched this fall than Jess Hawley of Dartmouth College. With a system of training peculiarly his own, he has developed championship elevens at the University of Iowa and at Dartmouth. Last year, the Dartmouth team smashed time and again through heavier opposing lines, winning every game played.

On these pages Mr. Hawley reveals how he has applied science to football to obtain such results, and explains the prearranged speed and stride from which his players never deviate. Never has there been published anywhere such a comprehensive, understandable article on the building of a successful football machine.

to begin with fundamental necessities.

From that standpoint, I should say that the most vital factor in college football is the psychology of tradition. Therefore, the first duty of a football coach is to steep himself and his staff in the tradition of the school—the honor for which his eleven will fight in play.

It also is tremendously important to fan undergraduate and alumni support and enthusiasm into active, hot flame. For this support and enthusiasm drives a sense of responsibility into the men on the squad. The story of school tradition becomes a thing to be cherished, semisacred; and there is born the vigorous determination to live up to its lofty standards.

A FEW years ago, in 1919 to be exact, we had an outstanding illustration of the loyalty that turns defeat into victory. Dartmouth was playing one of the strongest teams in the East. The game opened with a touchdown against Dartmouth from the kick-off. A fast man got the ball and our eleven wasn't fast enough to get him. To make matters worse, three minutes later a Dartmouth man fumbled, and our opponents made another touchdown.

Dartmouth was not good enough to beat that team, but Captain Jack Cannell—now my first assistant—called his team together and hammered tradition into it; called on those boys to demonstrate their right to wear the green jersey, an emblem for so many generations. The result was that that team went back into play with a dash and vigor that I had never seen it display—and won the game.

Given a background of tradition, the successful football coach then must turn to the systematic planning of team structure, as well as team development. The basis of team structure may be summarized by the phrases: "thorough understanding of the game," and "intelligent playing." Each player should be analyzed for the following inherent qualities, listed in order of their importance:

1. Courage
2. Physical skill
3. Mental capacity
   (a) Ability to understand theory of plan and its details
   (b) Fast decisions; initiative
   (c) Coördination of brain and brawn

WE, AT Dartmouth, call our department of psychology to our aid. No two of the men on a football squad are alike. The knowledge given the coach by his staff of psychologists enables him to bring about the proper reaction from each of his men when the occasion for it demands.

The psychologist also aids the coach in summing up a candidate's native ability to coördinate brain and muscle. Definite tests have been evolved at Dartmouth. I could not, in loyalty, disclose all of these, but I can safely cite one of the simpler and yet important ones.

The candidate is placed before the coach, face to face, with the psychologist acting as a sort of referee.

"Follow my words, not my movements," explains the coach. "Hands on hips; hands on shoulders; hands on head."

Those orders, with the coach and candidate going through the corresponding motions, are repeated variously and with increasing rapidity several times, and then comes the order:

"Hands on hips; hands on shoulders; hands on head." But the coach places hands on hips or shoulders instead of head. That simple test in brain and muscle coördination—quick thinking and quick telegraphy of thought to muscles—has sounded the death knell of hope for many otherwise well-fitted candidates.

Jess Hawley

Football followers everywhere are expecting the red-headed Chicago business man who coaches Dartmouth to produce once again a championship eleven for his Alma Mater

The importance of such coördination has been displayed strikingly by Princeton on several occasions. It is traditional of Princeton coaching that much emphasis is placed on the fact that in every football game there is a loose ball, and Princeton players must take advantage of every loose ball. Sam White displayed its value very nicely in 1919 when, in games with Harvard and Yale, he grabbed the loose balls for winning touchdowns, and repeated against Harvard in 1920.

Courage, the great self-effacing heart of a man, that is vital. Without courage, intellectual capacity, brawn, skill—all sink into nothingness.

Two years ago Larry Leavitt, Dartmouth fullback, gave a striking illustration of what sheer courage will do.

We had gone up against a team that displayed unexpected ability. Leavitt was not in the best physical shape, and we were holding him back for what we considered a more important game. Toward the end of the last half, however, the score was a nothing-to-nothing tie, and the ball was in our possession in the middle of the field.

LEAVITT begged to be sent in. He was. With him, the team found one weak spot in the opponents' line—just one. Again and again Leavitt plunged through that spot. Hurt, tired and battered, he wouldn't quit. Every time he hit he gained from three to four yards; never more; never less. With tears in his eyes, but with joy and tremendous courage in his heart, he fought on until he had smashed his way across the goal line—winning the game for Dartmouth.

With a team structure composed of men who possess the fundamental qualities that I have outlined, the coach is in position to develop a championship team. The remainder is up to him. Taking his men as individuals into consideration, cataloguing the maximum abilities of each, the coach then must plan the football possibilities for them.

Perhaps he finds that the team he has selected from the material that is available is lighter in weight than any other team represented on the forthcoming schedule. If so, his plan of play must be formulated in accordance with the utmost that can be derived from his squad—maximum possibilities again. It is under such circumstances that the element of timing of play, or rhythm, enters largely into the calculation.

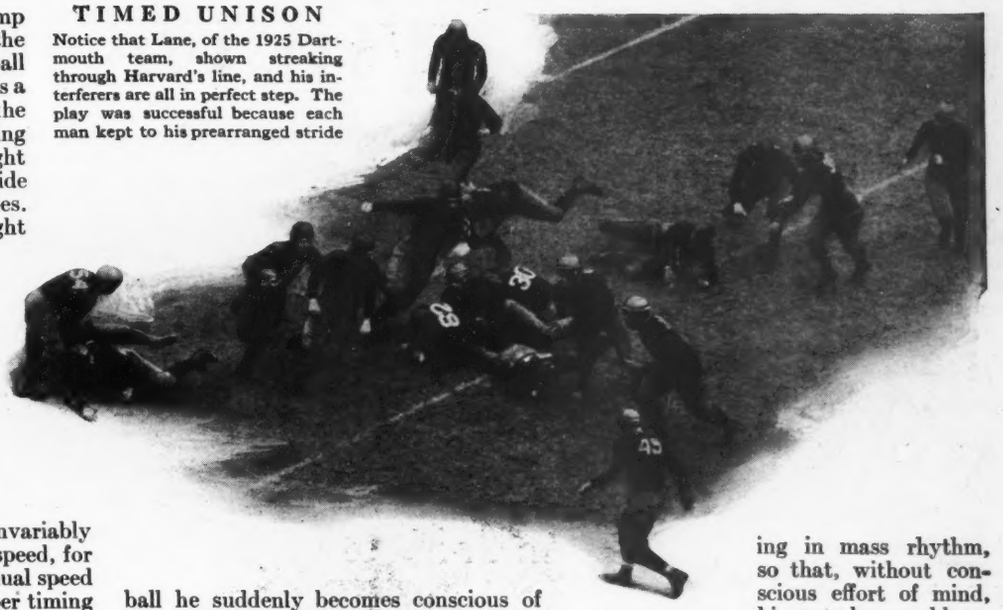
OF COURSE, the greatest possible speed of rhythm should be developed, and the lighter the team, the greater the team speed must be, and the more accurate. Very seldom do you see a heavy team display as much speed as a lighter one is capable of showing, and that is what gives the lighter team a more even chance when heavily outweighed—speed of rhythm.

That can be understood by recalling the reported effect of the Charleston on dance floors, compared with the fox trot, or one-step. Both the fox trot and the one-step are rhythmic. They can't be anything else; but the rhythmic beat in those dances is different, slower, than the succession of beats in the Charleston. It is the difference in the beat timing that puts a dangerous strain on dance floors when a group engages in the Charleston.

Proper timing, or rhythm, also enables

every man on the team to jump into synchronized action at the exact instant in which the ball is being put into play. And that is a tremendous advantage. It is the futile effort to do that very thing by players who are not taught properly that results in off-side playing, and consequent penalties. Coördination of rhythmic thought and action prevents off-side play. Mere rhythm of motion will not do it. Exact timing of thought with action is absolutely necessary.

The way in which that coördination is brought about, if the player is capable of accomplishing such coördination, is through speed—speed of every action in practice or in play. When I put my men through practice I invariably demand, and force, speed, top speed, for it is only when maximum individual speed is being employed that the proper timing of team play can be brought about.



TIMED UNISON

Notice that Lane, of the 1925 Dartmouth team, shown streaking through Harvard's line, and his interferers are all in perfect step. The play was successful because each man kept to his prearranged stride

OF COURSE it is not possible for each player to have the same speed capacity—some are slower, some are faster. The coach then must make his plan of play in accordance with individual speed as well as group speed. The slower boys are put where they have less ground to cover in order to arrive at their objective, but they are put where their top speed must be exerted.

In the diamond formation, for instance, the man who is at the line tangent of that formation is slower than the men who are back of him. But because all of them have practiced and learned that play at top speed, and timed speed, they deliver their full force in exact unison.

Another phase of playing that is dominated by rhythmic coördination of mind and muscle is the catching of punts. A fumbled punt almost always is the result of self-consciousness on the part of the player. In his effort to catch the ball he suddenly becomes conscious of his opponents thundering down upon him, or some other factor may enter into the play that makes him mentally conscious of his effort and so disturb the balance of rhythmic coördination.

FREQUENTLY coaches themselves are responsible for the creation of that imbalance, and many an excellent back has been ruined through coaching tactics alone. Suppose, as an example, a back drops a punt or two in practice under conditions in which he really should have caught the ball. The coach is so likely to berate him, maybe chase him from the field for the day. In most cases the psychological reaction is disastrous, for the next time that back is called upon to catch punts he is so self-conscious, so over-eager, that he will fumble the ball in most cases.

I would handle that back in a different way. He needs no scolding. His mind and heart, both, were in the catching of the ball. He needed more training in mass rhythm, so that, without conscious effort of mind, his muscles would respond unerringly and mechanically to the situation that his brain had encompassed.

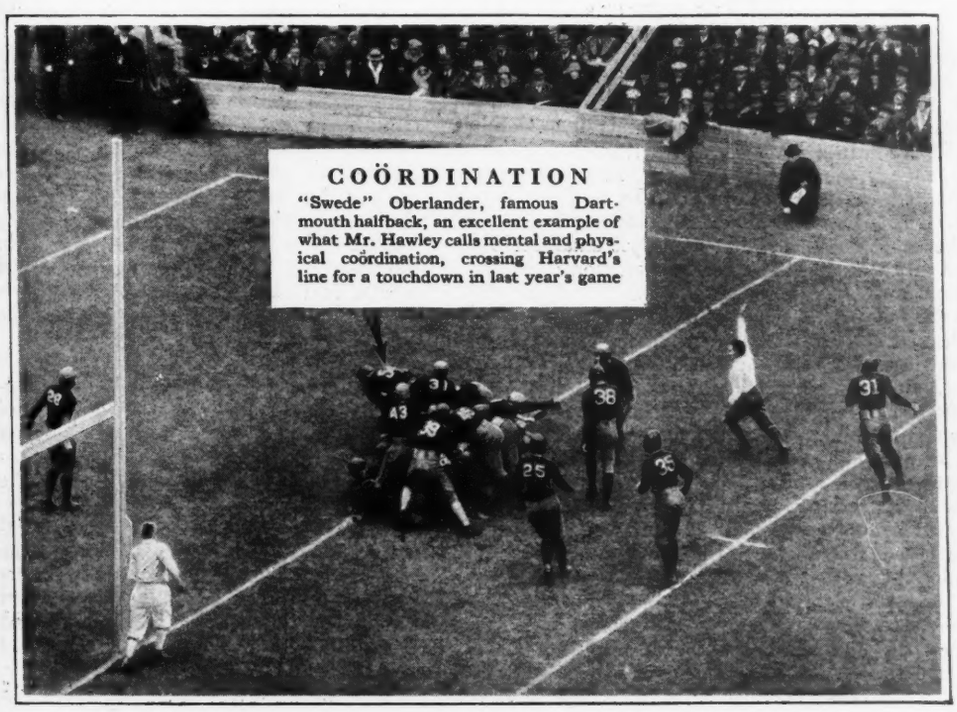
To give another example of mass efficiency due to rhythm, I might point to the military drill. The best-drilled company is the one whose drillmaster has an exact sense of rhythm, and who can give his commands in accordance with that sense. The best track men are those whose sense of rhythm tells them the fraction of the second at which the starting gun will speak. Some of them have the sense of rhythm so coördinated with physical rhythm that they can "jump the gun" by a split second, and so obtain a great advantage in the sprints.

IT IS impossible for me to go deeper into this matter of rhythm, but you all remember the Four Horsemen who won fame for themselves on the Notre Dame eleven of 1924. It was their application of rhythm and speed, consciously or not, that made them so formidable despite their light weight.

I train my men to measure their opponents' strength at the beginning of play. They swing into this guard or that guard; play this tackle or that tackle; plunge center, or run ends.

And when they have found the most vulnerable spot, they hammer, hammer, hammer with timed power at that man, breaking his physical strength, disturbing his mental poise, and, sometimes, routing his courage.

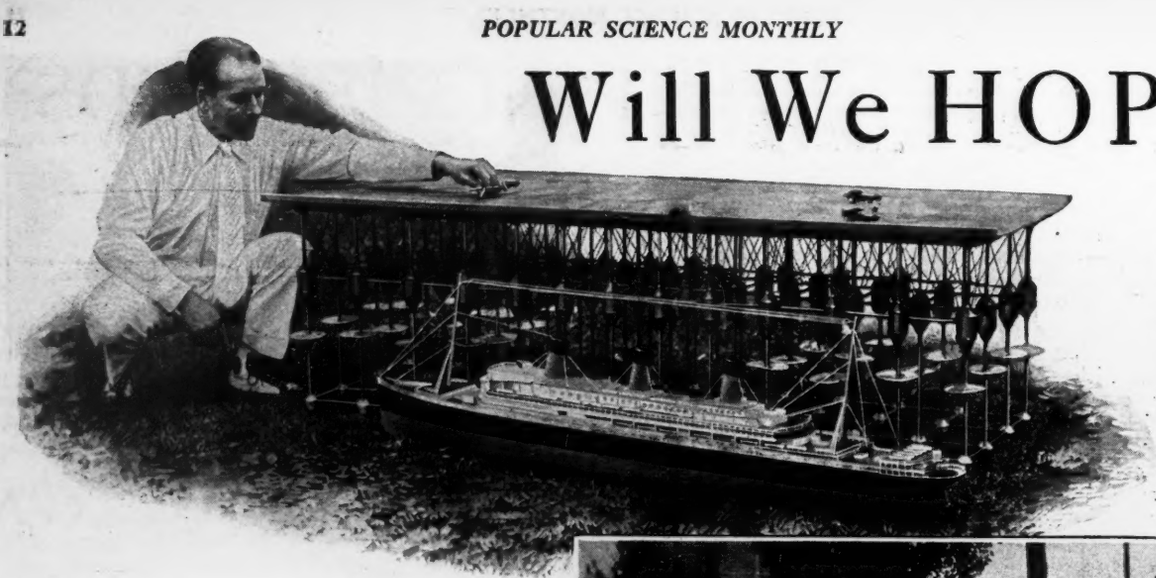
There is one more problem that confronts a coach. That is physical training. Every man has his physical capacity, and that must be jealously and zealously guarded. The player who is kept going up to his maximum physical ability soon begins to break under the physical strain, but the player who is kept going close to the limit of his physical capacity keeps perfectly fit. There must be a balance. When players are driven beyond their individual physical capacities, team play goes to smash.



COÖRDINATION

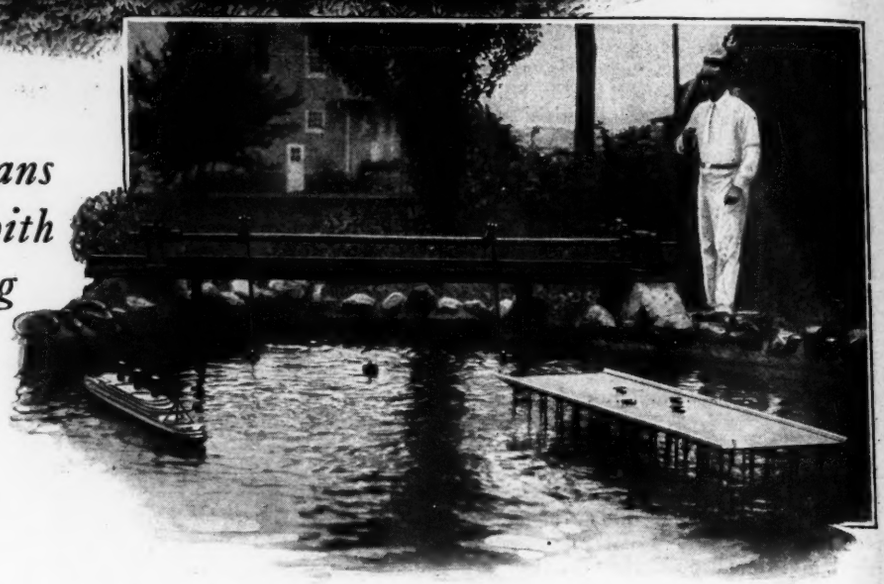
"Swede" Oberlander, famous Dartmouth halfback, an excellent example of what Mr. Hawley calls mental and physical coördination, crossing Harvard's line for a touchdown in last year's game

Will We HOP *the*



Edw. R. Armstrong with his model "floating dock" with which he demonstrated recently, to a notable gathering of engineers, his plan for mid-ocean airplane landing stations. The model of the *Majestic* was used for contrast

American Engineer Plans to Span the Atlantic with Mid-Ocean Landing Fields, Enabling Airplanes to Make the Flight in 34 Hours



The high spot of the remarkable demonstration occurred when Mr. Armstrong operated a wave-making machine, shown above, duplicating, relatively, heavy sea conditions which rocked the model *Majestic* like a cork but didn't budge the floating dock. Eight such seadromes, Mr. Armstrong hopes, will bridge the Atlantic, providing landings for planes

A BROAD-SHOULDERED, deep-chested, active man, whose sunburned face, contrasted markedly with his blond hair, and whose costume of white trousers, sport shirt and rubber-soled shoes suggested a tournament tennis player, stepped briskly to the edge of the swimming pool on his picturesque estate at Holly Oak, Delaware, a few weeks ago.

In his arms was an odd contrivance—a flat metal sheet, six feet by two feet approximately, supported by fifty-two spindly rods that resembled arrow shafts and were trussed and braced like a miniature bridge. About a foot from the top, each rod was thrust through a double-pointed cylinder of translucent material. Six inches or so below the cylinders, the sixteen rods at each end carried each a disk of the same translucent material, four or five inches in diameter.

Carefully, gingerly, the man leaned over the wall of the pool and placed his frail-looking burden in the water. It sank slowly to about three quarters the length of the rods, and finally came to rest with the cylinders almost completely submerged and its metal platform a foot above the still surface of the water.

The white-clad man quickly fastened a line from one end of the floating platform to a small red buoy. Then he placed beside the platform a five-foot scale model of the ocean steamship *Majestic*. Floating there, the two objects suggested a great trans-Atlantic liner about to be moored to its pier.

The man strode to a corner of the pool and seized a vertical metal lever, which he began to move back and forward with sweeps of his muscular arm. As the lever moved, a plank, hinged lengthwise below the water level across the corner of the pool, rocked up and down, churning up waves which swept across the pool toward the platform and the model liner. In a few seconds the mirrorlike pool was transformed into a miniature North Atlantic in winter. The howl of the gales was the only element lacking to make this demonstration a perfect small-scale replica of the fiercest ocean storm.

IN A group of men clustered on one side of the pool while this was going on were distinguished engineers, naval architects, aviation experts and officers of the Army and Navy air services. Members of this group began to nudge one another, to point, to talk in excited whispers. For they were witnessing a spectacle that was not only unique in their experience but apparently contrary to all known principles of physics.

Here were two bodies floating in water that was being agitated into waves which in proportion to the size of the bodies obviously exceeded in amplitude and intensity the mightiest rollers with which ocean steamships have to cope; and yet, while one object pitched, tossed and otherwise behaved as a buoyant body should in turbulent water, the other remained still and level as the proverbial billiard table!

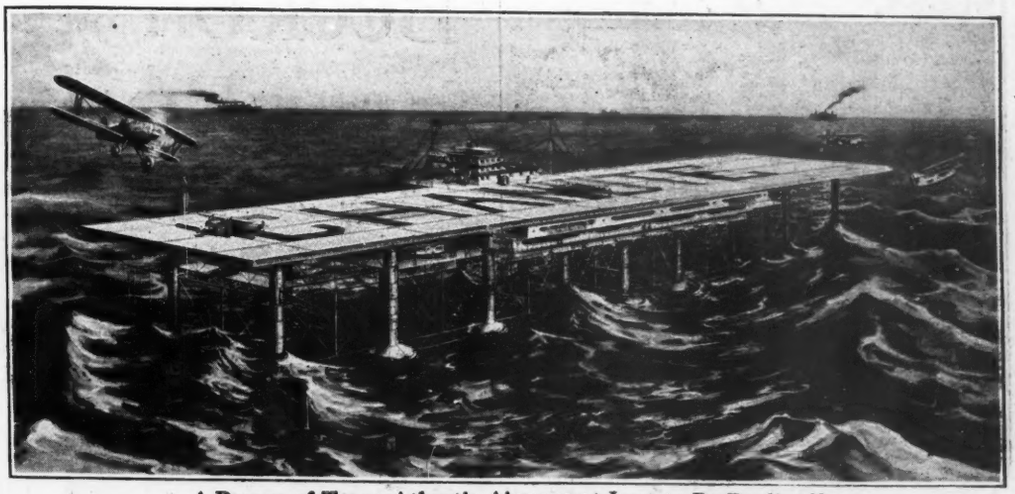
For the queer structure which was the first placed in the pool had not moved. Around it and beneath its platform the water rose and fell; waves reflected back from the sides of the pool collided with new waves created as the demonstrator moved his lever, causing sudden upheavals, quick gushes and whirling eddies. The tiny liner was swamped in no time, but the pierlike platform stood stable and still as though its supports were solidly embedded in the floor of the pool.

THUS was consummated a demonstration which, in the opinion of some of those who observed it, may eventually usher in a new era in transportation and so take rank with the epochal events of the world's history.

The odd platform which seemed impervious to the action of the waves is the perfected model of a mid-ocean landing station for airplanes, invented by Edward R. Armstrong, head of the mechanical experimental development division of E. I. du Pont de Nemours & Company. Ten years ago Mr. Armstrong, who was

Ocean *on* FLOATING ISLANDS?

By
RAYMOND J. BROWN



A Dream of Trans-Atlantic Airways at Last to Be Realized?

Airplanes, of course, flying over water, can land on "mother ships" such as naval air fleets provide. But such landings are hazardous, owing to the rocking of the boat. The invention of floating platforms which remain fixed during fiercest storms offers an achievement which may remove the last obstacle to transoceanic air service

the white-clad man who conducted the test of the device, conceived the idea of establishing trans-Atlantic air routes through the use of landing platforms for planes set at regular intervals across the ocean. With this demonstration he presented scientific proof that his idea is not a fantastic dream but a sound, practical conception capable of useful application to the present-day needs of ocean transportation.

He proved, in short, that the landing station he has devised would remain safe, stable and seaworthy under the worst possible conditions of ocean storms—storms that would sink the largest liners in a few seconds. For, although the liner and air station used in the test were exact models of the devices they represented, being constructed on a scale of a sixteenth-inch to a foot and matching the actual vessels in relative weight, displacement and strength of materials, the miniature ocean storm brewed by the wave-making machine was at least twice as severe as the worst Atlantic storm in maritime records. The highest waves ever measured in the Atlantic were between forty and fifty feet. Each inch of wave raised in the swimming pool, though, was equivalent to sixteen feet of ocean wave, and some of the waves developed during the test reached a height of six to eight inches, representing ocean waves of a hundred feet or more.

THE idea behind Mr. Armstrong's invention may be simply expressed. Airplanes designed to carry passengers and freight are incapable of flights of more than four or five hours' duration; that is to say, of more than about 400 miles. For longer flights or swifter flights, the planes must sacrifice carrying power for storage space for fuel and oil. This has been demonstrated on commercial airways in all parts of the world.

As a stunt, a single plane especially designed and equipped for the flight may make a nonstop trip between America and Europe. Such a plane, though, would be entirely useless for commercial work. To make a trans-Atlantic airway possible, the planes must have mid-ocean landing stations at intervals commensurate with the distance at which the landing fields of commercial land airways are set apart.

Vessels similar to the "mother ships" and airplane carriers of naval air fleets would be inadequate for the purpose, principally because their movements under the force of the ocean waves make the landing of airplanes on their decks a hazardous feat to be accomplished only under favorable conditions. For a commercial service, proceeding under a strict schedule, landings must be effected in any weather and under any condition of ocean disturbance in which the planes arrive.

A MID-OCEAN landing field for airplanes, then, must be a structure that will neither move from its station nor lose its stability under stress of the most rigorous storms, gales and seas.

The problem of producing such a structure occupied Mr. Armstrong for ten years, and the solution he found is in the highest degree ingenious.

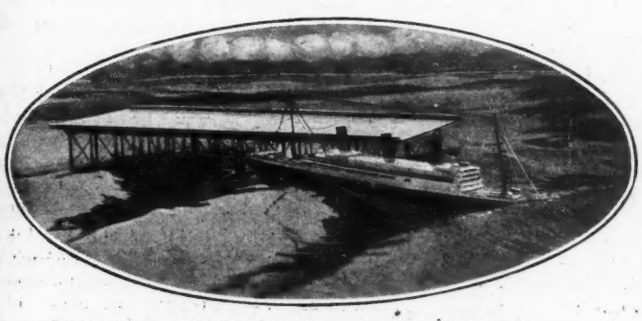
To understand the principles on which the "seadrome," which is the inventor's own name for his device, operates, it is necessary to review briefly some elementary facts regarding ocean waves. To begin with, waves in the ocean are accompanied by virtually no horizontal motion of the surface. The motion is vertical, comparable, in a way, with the motion of a tablecloth which is being flapped up and down by two persons holding its corners.

Also, there is no disturbance of the water at depths exceeding about fifty feet even when the most severe waves are rolling. If a submarine boat, for example, were to be stationed fifty feet or more beneath the surface of the sea while a great storm was raging, its occupants would feel no pitching or rolling.

The seadrome obtains its buoyancy from the cylinders that are mounted on its supports. Floating on these alone, the device of course would rise and fall with the waves just like any other floating body. Mr. Armstrong has designed his seadrome, however, so that about ninety-five percent of its displacement is below the water affected by wave motion on the surface, and the disks on the end shafts, which the inventor calls "dampers," are below the area of disturbance.

In consequence, the seadrome is to all practical purposes constantly in still water. Each time the structure tends to rise at the motion of the waves, the damper disks resist the upward motion like sea anchors. In order for the seadrome to move with the waves, it would be necessary for these disks to lift the tremendous weight of the great volume of water that is resting upon them. The effect, then, is that the seadrome is riveted to the still water under the surface, while the waves at the surface pass harmlessly through the open structure under the landing platform.

THE periodic nature of the rise and fall of sea waves, of course, is responsible for this stability. Were the water to rise or fall slowly and gradually and remain at rest when it reached its maximum or minimum height, the seadrome would rise or fall with it. However, with waves rising and falling rapidly and with regular vertical motion, each time the force of a wave is directed against the seadrome, the damper disks check the structure's tendency to take on the motion of the wave until the force of the wave is dissipated, or at (*Continued on page 144*)



Demonstration with the miniature seadrome and *Majestic*, contrasting the stable platform and plunging vessel in a rolling sea

William Tomkins (right), who after years of study has just completed a dictionary of the mysterious Indian sign language

When You Beckon *with* Your FINGER

You Are Using the Sign Language of the Indians--New Studies Tell How to Interpret Their Gestures

By PAUL A. WILLIAMS

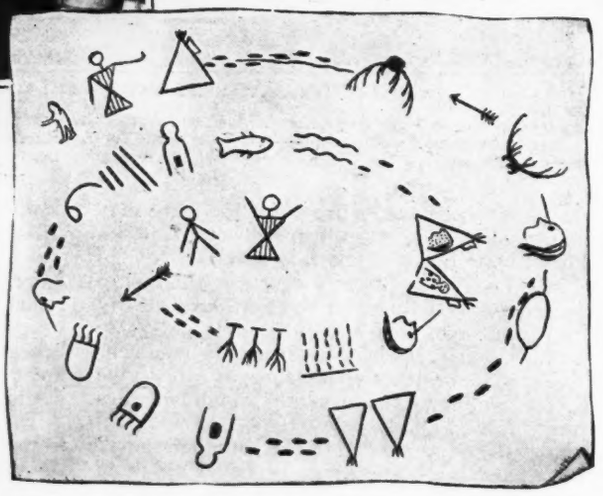
WHILE Crown Prince Gustav Adolph of Sweden was touring the United States recently, he was introduced to one of the most interesting languages in the world—the sign language of the American Indian.

It was at Los Angeles, during ceremonies by which the Prince was installed as a member of the great Arapahoe tribe. Seated on a blanket, surrounded by feathered braves, the future Swedish ruler watched with rapt attention while the tribesmen went through the ceremonial, speaking their silent welcome by means of earnest gestures.

Every one of the gestures conveyed a definite meaning, which was interpreted for the Crown Prince by Colonel Timothy McCoy, one of the few white men who understand the Indian sign language. At once the Prince was impressed by the effective simplicity with which men could convey their thoughts without words.

By coincidence, it was at about the same time that the fascinating secrets of this ancient language were revealed to us all in a book prepared by a man who has spent many years of his life among the Indians of the western plains—the Blackfoot, Cheyenne, Sioux, Arapahoe, and other tribes. He is William Tomkins, of San Diego, California. For forty-one years he has known the Indians and their language. As a boy, working on the cow range on the edge of the Sioux Reservation in Dakota back in the '80's, he made close friends among the redskins. He learned to talk with them, first by the signs understood by all Indians from one side of the continent to the other, then in their spoken languages. Ever since that time he has delved into the romance of America's first inhabitants, their customs, speech, and strange picture writings carved in the rocks.

His knowledge he now passes on to the rest of us in the form of a dictionary, entitled *Indian Sign Language*, of nearly 800 Indian word signs and their meanings. Most of these signs, like the ones illustrated here, are such wonderfully natural and graphic expressions of thought that they can be learned easily by everyone.



An Indian Picture Story

TO INTERPRET this story, start from the center of the spiral and work around the outer end. Note that each picture has a meaning. Here is the "translation."

An Indian and his wife had a quarrel; he wanted to go hunting and she did not want him to go. He took his bow and arrows and started into the forest. A snowstorm came upon him and he looked for shelter. He saw two teepees, but found that one contained a boy with the measles, the other a man with the smallpox. He ran away and shortly came to a river. He caught a fish, ate it, and rested for two days. He started out again and saw a bear. He killed the bear and had a feast. Then he came to an Indian village, but as they proved to be enemies he ran away to a little lake. At the lake he saw a deer. He killed it with an arrow, and dragged it home to his teepee, to his wife and his little boy.

In the dictionary, too, Mr. Tomkins has listed and translated 220 of the strange picture**words** which story tellers of the Sioux and Ojibway nations once carved in the rocks or painted on wood or leather. One of these picture stories, with the translation, is reproduced here also.

The Indian sign language, Mr. Tomkins says, has a romantic history unequaled by any other. It is probably the first American language. Certainly it is the first and only universal language. It is older than the pyramids, and it is the most important gesture language the world has ever produced.

Unquestionably it was born of necessity. In North America there were so many tribes, speaking so many tongues, that the continent was an immense Babel. When strange tribesmen met, if they were friendly, they managed to exchange a few simple sentiments by signs with their hands. During years of these occasional contacts, the signs increased in number until a Comanche and an Ohio Indian could carry on a long conversation without uttering a sound except an occasional grunt. Finally, the language grew to such an extent that tribesmen held councils, agreed to treaties, and planned campaigns, all with gestures.

As you look at the signs illustrated on these pages, you'll be surprised to see how natural and understandable they are. At least some of them, you'll say, are exactly the gestures you might use if you had to speak with your hands. In fact, a few of them are precisely the same gestures we palefaces actually use for emphasis.

For instance, who has not expressed the word "done!" by emphatically brushing the palms of the hands together? That is pure Indian. And how many times have you said, "Come over here," by beckoning with your finger? That's Indian, too.

Can you think of anything more expressive of "escape" than the Indian way of crossing the wrists, hands closed, then abruptly separating the hands, swinging them to right and left? Even more readily will you recognize the gesture for "give"—hand extended forward and downward, palm upward.

WHILE the meanings of some of the other signs may not be quite so obvious, you'd find it difficult to devise more perfect gestures for the thoughts they convey. Thus, the Indian idea of "mourning" is expressed by clipping with the fingers at the back of the head as though shearing off the hair; then, with the two forefingers, indicating tears coursing down the cheeks.

"Dance" is indicated by raising both

hands, pointing upward and wriggling them up and down quite in the manner of modern jazz singers. Holding the left hand palm upward, and squeezing the tips of the right hand fingers together above it, signifies "powder." Again, the idea of "corn" is conveyed by imitating the act of shelling corn. The left index finger and thumb are projected as though they were an ear of corn; then they are twisted by the corresponding fingers of the right hand.

"Woman" is indicated by making the movement of combing the hair, combined with a feature to indicate height as distinguished from another similar gesture lower down to indicate "girl." To say "book," the Indian would hold both hands in front of him, side by side, palms up, and look at them as if reading. If he continued the same gesture by sweeping his hands apart, he was saying "newspaper."

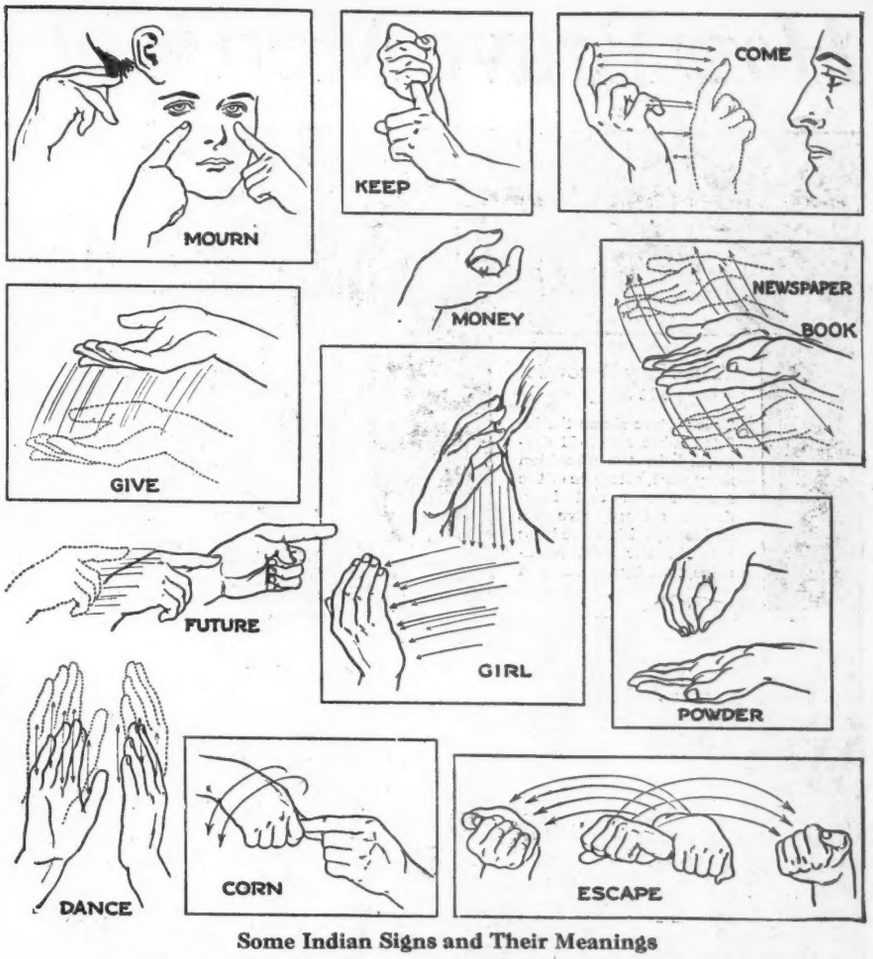
Especially interesting is the way the Indian would combine several signs to indicate one word. For example, to say "the President," he would combine three signs, for "whites," "chief" and "big," and then with the left hand point toward Washington. To indicate "whites," he would make the sign for "color" and then rub with the tip of the right index the small segment at the upper end of the left thumb nail. "Chief" was indicated by holding the right hand at the side, pointing upward, raising the hand in a gradual circle as high as the top of the head, then arching toward front and downward. To indicate "big," he would bring his hands together in front of him, palms in,—and separate the hands, bringing them apart but still opposite each other. All this means "President."

Similarly, "Bible" was indicated by combining the signs for "book" and "medicine;" "brave" by combining the signs for "heart" and "strong;" "bridge" by combining the signs for "river" and "across."

One wide difference between the Indian sign language and the signs used by the deaf and dumb is shown in the word "think." The originators of the Indian signs thought that thinking or understanding was done with the heart, and made the sign "drawn from the heart." Deaf mutes place extended fingers of the right hand against the forehead, to give the same meaning.

The deaf use a great deal of facial contortion and grimace. The Indians seldom used facial expression, but maintained a composed and dignified countenance, the signs being sufficiently expressive in themselves.

Naturally it is easier to learn to talk the sign language than to read it, for usually a sign sentence is made up of nouns and verbs that have many shades of meaning. The exact meaning of a sign must be determined by other signs accompanying it. Qualifying words, articles, prepositions, and so on, are absent.



Some Indian Signs and Their Meanings

That all races have the same emotions and the same instinctive expressions for them is strikingly proved in the gestures the Indians evolved. Many of them we ourselves use every day

Indians never bothered, Mr. Tomkins says, to find signs for "the," "a" and "an." They used the sign for "question" when they wished to ask one, instead of starting off with such words as "what," "where," "why," and "when." If one wanted to ask: "Will you make the fire?" he made the following signs:

Question — you work — fire.

"What do you want?" the Indian would express by the sign words:

Question — you — want.

The words "we" and "they" would be made by the signs: Me—all. He—all.

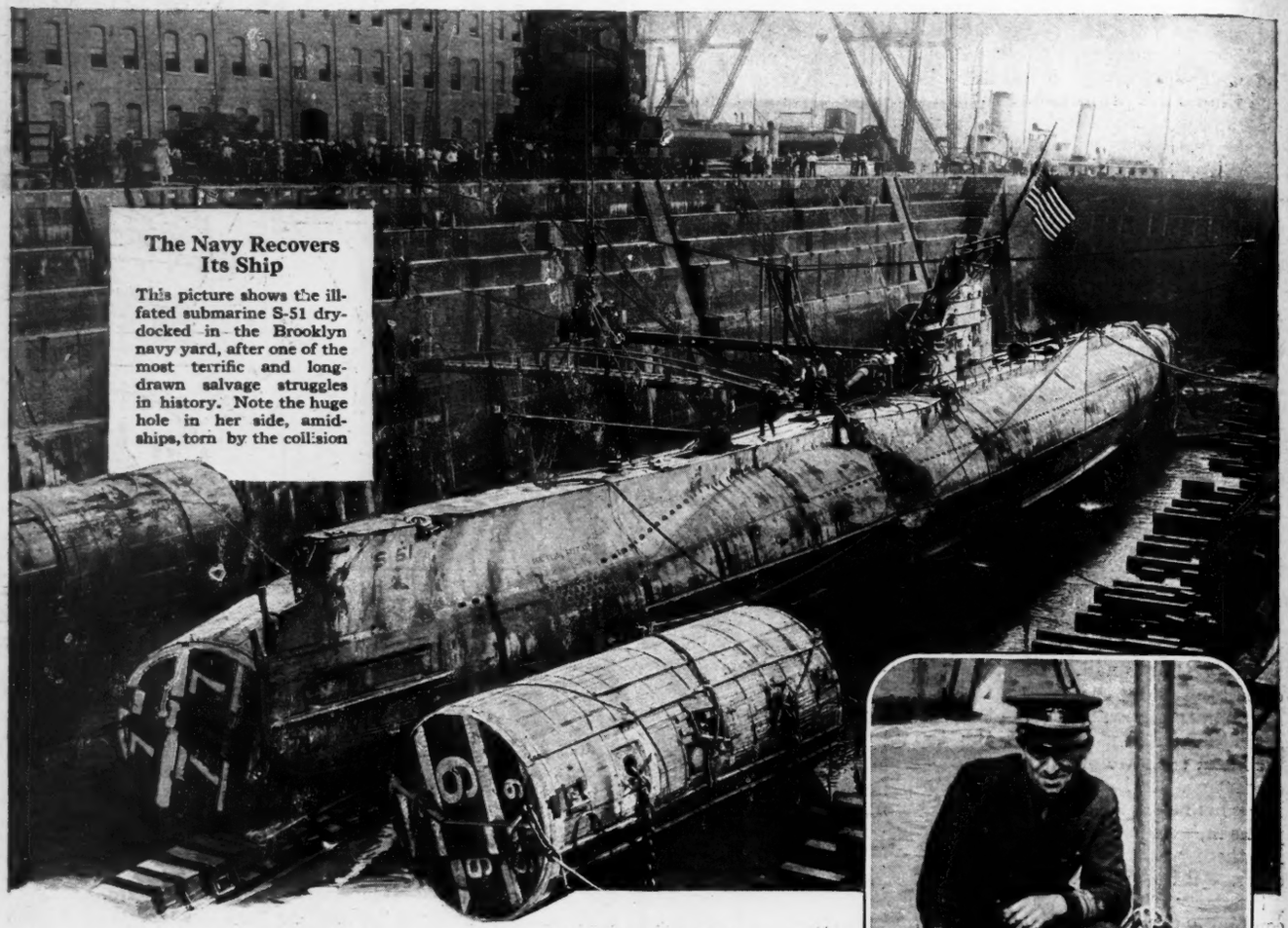
And the Indian's way of saying "he" or "she" was by adding the sign for "man" or "woman." Past tense was indicated by adding the signs for "long time."

These very crudities are the things that add charm to this picturesque language. Now that the signs are at last available and interpreted, many people, it is said, are learning to converse the Indian way.

The beauty of this sign talk, Mr. Tomkins emphasizes, depends upon the manner of making the gestures. Movements should not be angular or jerky, but should rather be rounded and sweeping in their rendition. It is inspiring and a thing of beauty, he says, to witness a sign conversation between two capable Indian sign talkers. The few who are left are living in many parts of our country, and, Mr. Tomkins advises, should be cultivated wherever found.

The Crown Prince of Sweden being made a member of the Arapahoe tribe. Colonel McCoy (standing) is interpreting the Indian sign language used in the ceremony

How Brave Men Cheated *the* Sea



The Navy Recovers Its Ship

This picture shows the ill-fated submarine S-51 dry-docked in the Brooklyn navy yard, after one of the most terrific and long-drawn salvage struggles in history. Note the huge hole in her side, amidships, torn by the collision

By LIEUT. COMMANDER EDWARD ELLSBERG, U.S.N.

Lieut. Commander Ellsberg, at the right, on the conning tower of the S-51 while it was being towed victoriously back to New York. Below: Salvage crew hooking up towing gear on the S-51's bow

A remarkably vivid story of the raising of the S-51, described as the most daring salvage job in history, is told here by Commander Ellsberg. Commander Ellsberg originated the plan, described in the June POPULAR SCIENCE MONTHLY, *by which the submarine, sunk in a collision off New England, was raised months later. This article presents the human side of the feat, the thrilling story of brave men who won a terrific battle with the sea.*

IN ICY blackness, 132 feet below the ocean surface, a diver lay digging a narrow burrow under the steel hulk of the submarine S-51, sunk off the coast of Rhode Island. With mittened hands he held the nozzle of a fire hose, which spat a powerful stream of water to pierce the clay which hugged the submarine fast to the ocean's bed.

Now he reached a point fifteen feet from the entrance of his burrow—no sight, no sense of direction except the feel of the buried submarine's metal hull against his back.

The diver was Chief Torpedoman Francis Smith, U.S.N. Clad in clumsy diving armor and helmet, and kept alive by a stream of air from above, he worked on. He was trying desperately to complete a hole through which heavy lifting chains might be passed beneath the grim tomb where thirty-three valiant sailormen died in September, 1925, after a collision with the steamship *City of Rome*.

Twenty-two fathoms above, we on the salvage ship *Falcon* waited anxiously. A sailor listened on Smith's telephone. Suddenly he heard a sound from below. He passed the telephone to me.

There came an agonized call. "I'm in a bad position, Mr. Ellsberg. Send some one to help!"

What had happened I did not know. On the opposite side of the submarine another diver, Eiben, was working. I seized his telephone and ordered him to go to Smith.

Again I called to Smith, "Shall I turn off the water?"

The reply was a scream:

"No, for God's sake no, keep it going! The tunnel has caved in behind me!"

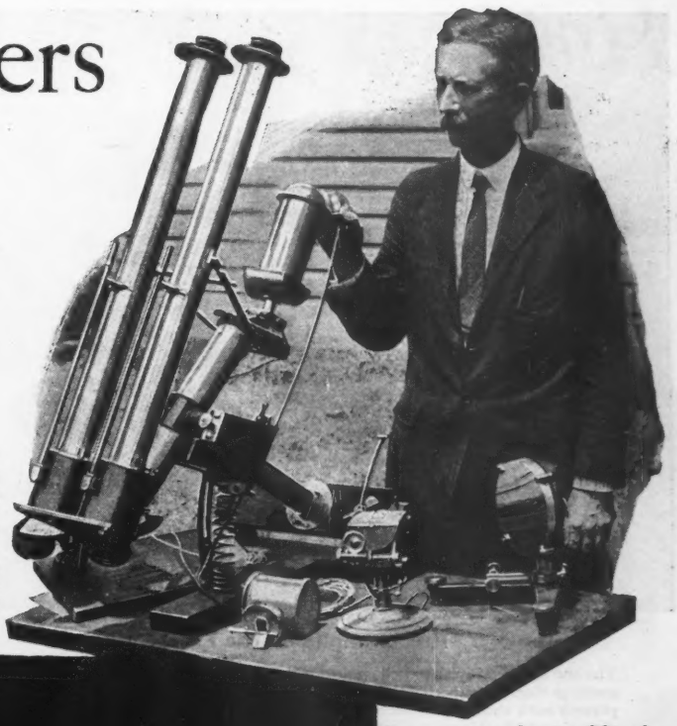
On deck we looked at each other, aghast, but the next instant Eiben called up that he was

(*Continued on page 146*)

The New Wonders of Our SUN

Exiles on Lonely Desert Mountain to Study Vast Power Plant of the Sky

By WILLIAM J. WHITE, JR.



Dr. Charles G. Abbot, Director of the Smithsonian Institution's astrophysical laboratory, with the "sun gun," one of the remarkable measuring instruments with which he has proved that the sun's radiation varies

IN A cave on the desolate summit of Mount Brukkaros, in the heart of a desert waste in southwest Africa, two American scientists soon will begin a most extraordinary vigil. In endless solitude, sixty miles from the nearest town of any size and six miles from the closest Hottentot village, they will spend their waking hours, day after day, with delicate instruments studying the mysteries of the sun.

Patiently they will keep at it. For in their strange vigil they will be inspired by the hope of wresting from the face of the sun new secrets of energy and radiation which may be of untold value to future generations.

The names of these scientists are William H. Hoover, head of an expedition sent out by the National Geographic Society in cooperation with the Smithsonian Institution, and Frederick A. Greely, his assistant.

AS YOU read this, they have embarked on a 10,000-mile journey by ship, railway, auto and burro to the mountain island in the desert, which will serve as the strangest observatory to be found anywhere on earth. With them is a sixteen-months-old baby, Mr. Hoover's daughter. With them also are thirty-five cases containing marvelously delicate astronomical instruments, fifteen cases of photographic plates, a gasoline engine to generate power for the instruments, a gasoline stove, cooking utensils, books, a phonograph, and a large number of records. All these, in the final stage of their hazardous journey, they must transport over mountain passes called "the most desert spot in a desert."

This dreary observation post was established a few months ago by Dr. Charles G. Abbot, director of the astrophysical laboratory of the Smithsonian Institution, who for more than thirty years has studied the sun and its mysteries. Here the two scientists acting as Dr. Abbot's outposts will face months of isolation in the wilderness to carry on his attempts to solve for mankind the riddles of the fiery power plant of the sky.

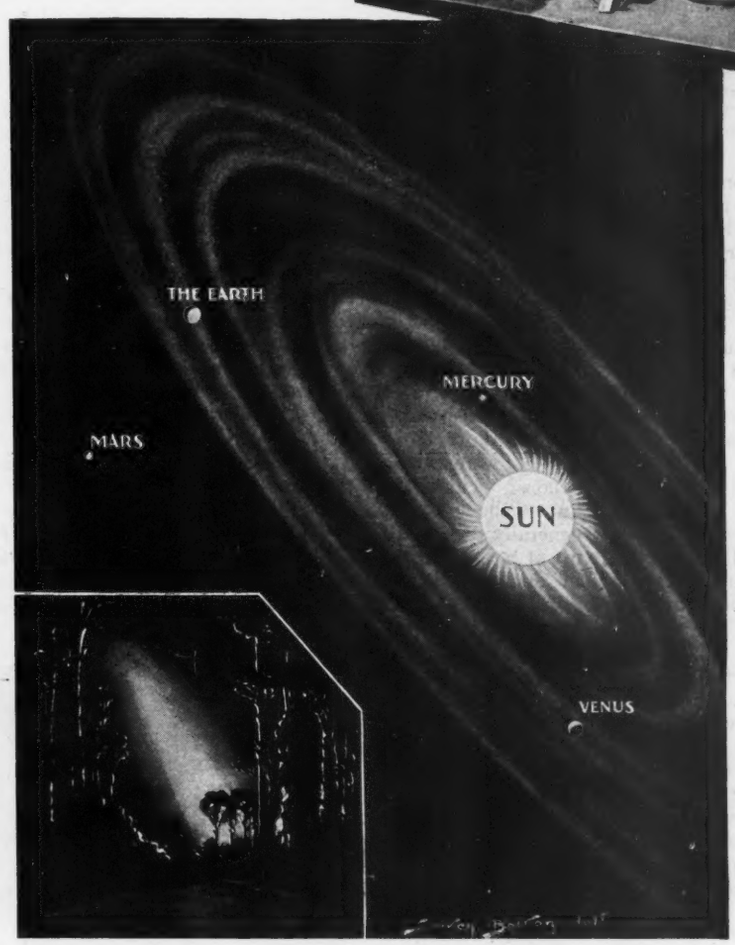
For ages men have thought of the sun as an unchangeable giver of warmth and light. But is it actually so dependable, or do its radiations vary from day to day? If so, how do these variations affect our weather and our daily life on earth?

Right now the face of the sun is passing through one of its periodic eruptions of sun spots, which began in 1916. Just what are these spots, and how do they influence us?

WE KNOW that the sun is a tremendous power plant, generating billions of horsepower every second. Can we ever learn to turn this endless source of power to run our machinery? And if so, how?

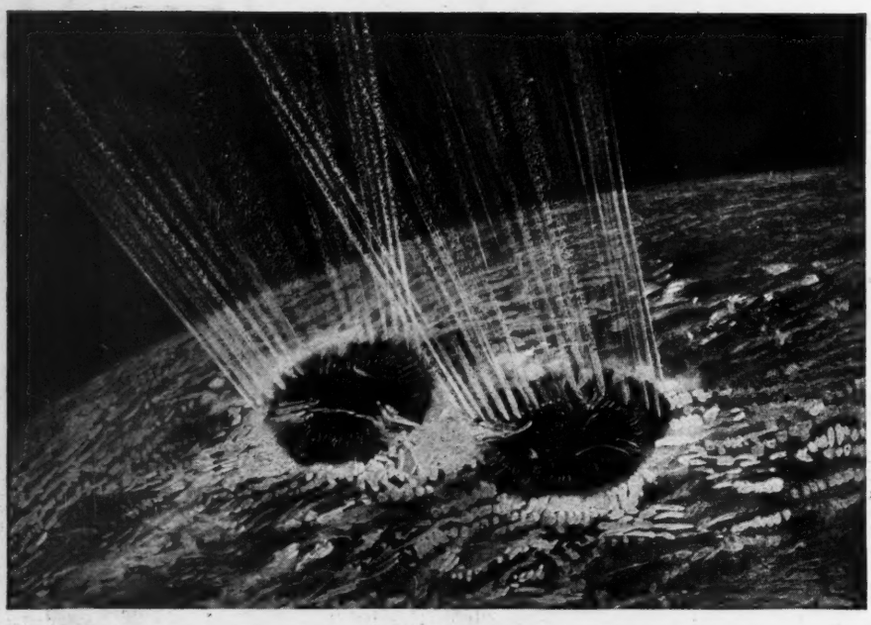
These are a few of the fascinating problems which science seeks to answer. As for the first of the questions, the constancy of the sun, Dr. Abbot already has established the fact that the sun's radiation does vary from day to day. In his years of experiment he was one of the first scientists to advance the theory that these variations affect our weather.

To test his theory, Dr. Abbot established two observatories in the western hemisphere—one at Calama, Chile, and the other atop Mt. Harqua Hala, Arizona. Both of these places were selected because of the slight rainfall and the clarity of the atmosphere. Each day the sun's heat is recorded at both places, and from that the solar constant is figured. This impos-



A Vast Sun Belt—Does It Affect Our Weather?

Astronomers who have observed this enormous ring of light encircling the sun believe that it is a flat ring of matter, somewhat like the rings of Saturn, extending more than a hundred million miles into space, far beyond the earth. The smaller picture shows how it has appeared from the earth after sunset—a faint, cone-shaped band of light stretching up from the western horizon. Spectroscopic observation indicates that it is composed of solid particles shining by reflected sunlight



Huge Pimples on the Face of the Sun

The sun spots, which are believed to affect our weather, are immense volcanoes which shoot great geysers of superheated gases far out into space, and bombard the earth and other planets with showers of electrical bullets. According to one theory, they are produced by gigantic whirlpools set up between the moving layers of gases within the sun. One of these spots observed last January was found to have a diameter of 40,000 miles—or about five times that of the earth. Scientists are trying to learn the reason for these spots

ing term means nothing more than the heat of the sun that would be recorded on a thermometer located outside the great bag of atmosphere that surrounds the earth. The figures from both stations are then telegraphed to Washington. They have been found strikingly alike when compared daily, while the change in the figure from day to day has proved to Dr. Abbot's satisfaction his theory that the sun's heat fluctuates. The next thing to determine is *how* this variation affects the weather. Given that, long range forecasting will be an actuality.

BUT first Dr. Abbot wanted a further check on his theory. Possibly the stations' figures were much the same because they were located so near to each other. He decided to seek a dry spot in the eastern hemisphere.

With that end in view he left Washington a year ago for a trip around the world. One site after another was discarded until he reached Mt. Brukkaros.

Men like Dr. Abbot who are making the sun their life study believe that if they can solve the mystery of the sun spots the rest will be easy. Why do these spots vary in numbers? What is the explanation of the eleven-year cycle of their appearance?

If you take a baseball in your hand, twirl it, and watch the stitching travel in a sort of arc toward the center and then away from it, you will have a fair idea of the motion of the spots across the sun's face. They first make their appearance at the upper edge, but have no effect on the earth until they reach the central meridian. When they are sixteen degrees north or south of the sun's equator their effect on us is the greatest. Then they pass out on the other side. But if large enough they may appear again when the sun has completed his round, which takes from twenty-five to thirty days.

Many of these spots are large enough to be seen without the aid of a telescope, using, of course, smoked glasses or a piece of densely fogged photographic film as protection for the eyes. The large spot observed in January last had been visible on several previous rotations. When it reached its period of greatest intensity it was found to have a diameter of about 40,000 miles. If five worlds the size of ours had been lined along just one half of that crater they could have all been pushed in at one time without touching one another.

What causes these tremendous volcanoes? Scientists would give much to know the answer. It is now pretty generally believed that the sun is made up of a number of layers of gases—all in motion, but at varying speeds. Dr. J. H. Jeans, the British scientist, believes that these layers rotate faster toward the surface, just the opposite of the action of the earth.

The different speed of these layers has the effect of setting up whirlpools or vortices. If you stand on the rear platform of a train you will notice bits of paper swirling in its wake, the result of the partial vacuum caused by the swift passage of the train. In any body of water where there is a swift current, or currents of varying speeds, such as Niagara Gorge or Hell Gate, New York, whirlpools are set up. The same phenomenon is believed to happen in the sun.

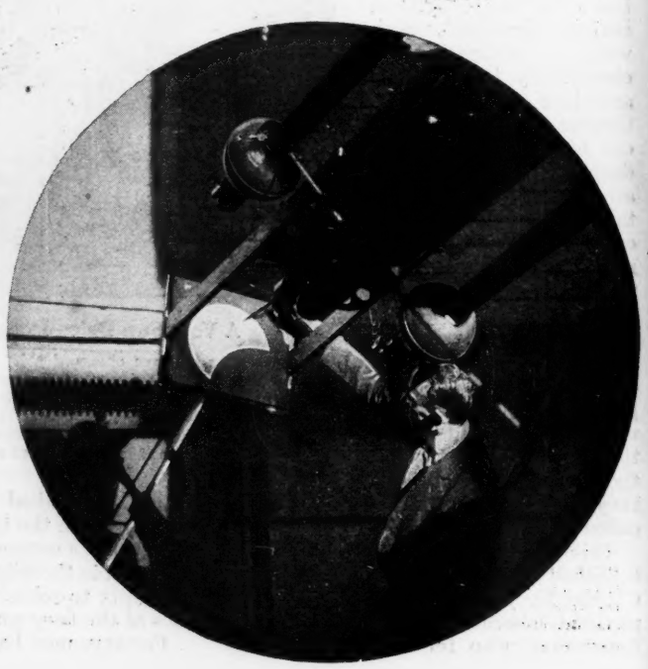
BETWEEN each pair of layers an immense vortex is created, extending clear around the circumference. With the increase in friction this whirlpool grows and seeks an outlet. The tremendous energy finally forces openings through the top layer of the sun, in the same way that water whirlpools become waterspouts. Out shoot great volumes of gas which continue to pour forth until the internal pressure has been relieved. It's just as though the sun had occasional stomach aches caused by the formation of gas. When that pressure has subsided to the extent of being less than the weight of the sun's outside layer, the breach closes up.

These spots seem to travel in pairs, one on each side of the sun. The motion of the gases in one is always the opposite of the other. Here's the way that is explained:

If you draw an oar blade through the water you set up a tiny whirlpool. Close examination will reveal that the direction of the whirl where the oar leaves the water is opposite to that of the point of entry. It's the same principle exactly in the sun. Follow that great vortex around the circumference from the first break to the other, and you'll see how the direction of the twist changes.

POSSIBLY you and your friends were disappointed with the performance of your radio sets last winter. The trans-Atlantic tests were a complete failure. All that, the scientists say, is chargeable to the sun spots. It has been known that they affect telegraphic and telephonic communication—on a day last January operation on almost all long distance lines was virtually suspended for an hour—but the effect of those solar volcanoes on radio broadcasting was principally a matter of conjecture until last winter.

But these dis- (*Continued on page 148*)

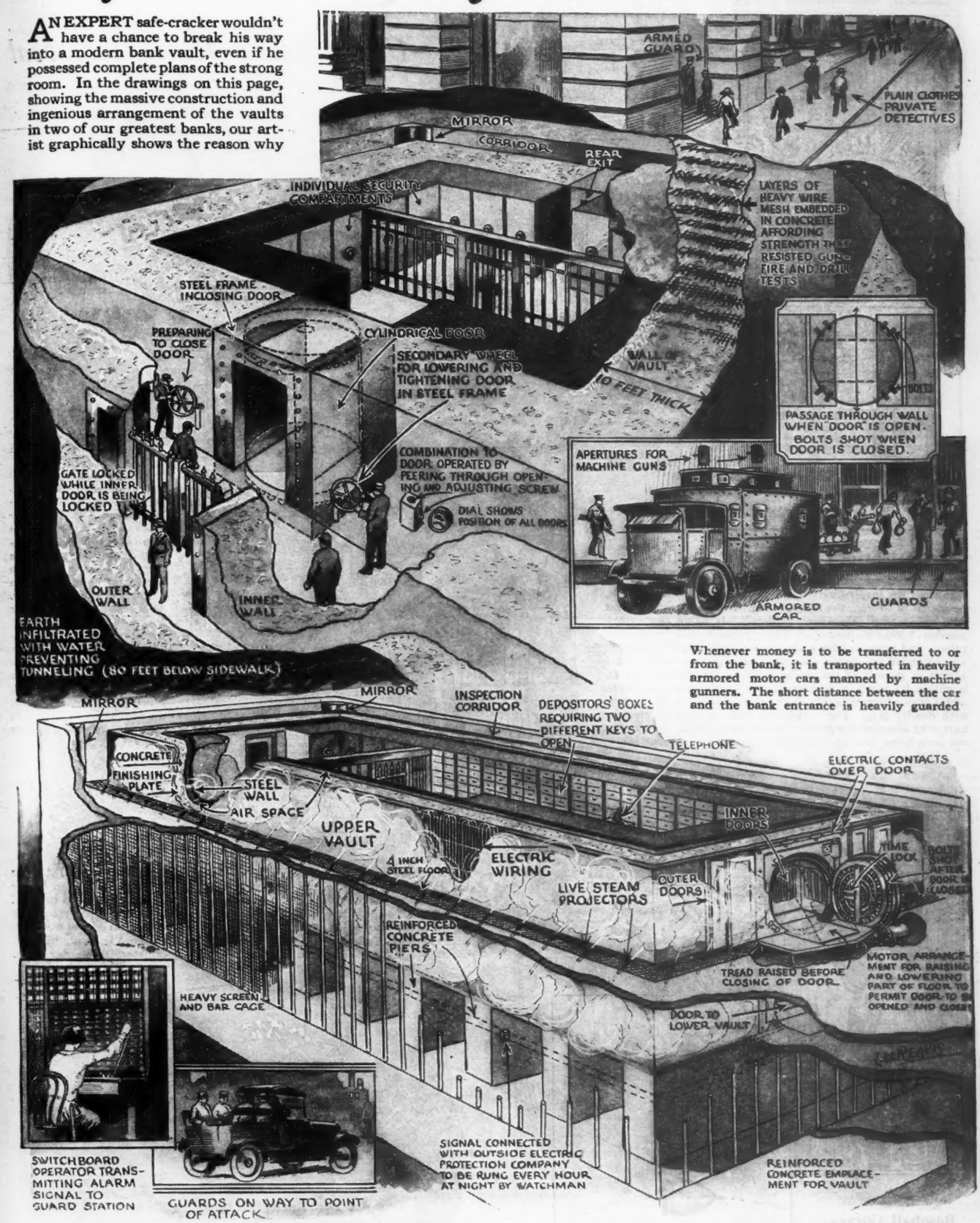


How Astronomers Study the Sun

A partial eclipse of the sun, as seen through the giant telescope at Harvard Observatory. It is during eclipses, when the moon passes between sun and earth, that we gain our knowledge of solar wonders

Why Your Money *Is* Safe *in a* Bank

AN EXPERT safe-cracker wouldn't have a chance to break his way into a modern bank vault, even if he possessed complete plans of the strong room. In the drawings on this page, showing the massive construction and ingenious arrangement of the vaults in two of our greatest banks, our artist graphically shows the reason why


ARMED GUARD
PLAIN CLOTHES PRIVATE DETECTIVES
MIRROR
CORRIDOR
REAR EXIT
INDIVIDUAL SECURITY COMPARTMENTS
LAYERS OF HEAVY WIRE MESH EMBEDDED IN CONCRETE AFFORDING STRENGTH THAT RESISTED GUN-FIRE AND DRILL TESTS
STEEL FRAME INCLOSING DOOR
PREPARING TO CLOSE DOOR
CYLINDRICAL DOOR
SECONDARY WHEEL FOR LOWERING AND TIGHTENING DOOR IN STEEL FRAME
WALL OF VAULT
TO FEET THICK
PASSAGE THROUGH WALL WHEN DOOR IS OPEN. BOLTS SHOT WHEN DOOR IS CLOSED.
COMBINATION TO DOOR OPERATED BY PEERING THROUGH OPENING AND ADJUSTING SCREW
DIAL SHOWS POSITION OF ALL DOORS
APERTURES FOR MACHINE GUNS
GATE LOCKED WHILE INNER DOOR IS BEING LOCKED
OUTER WALL
INNER WALL
EARTH INFILTRATED WITH WATER PREVENTING TUNNELING (80 FEET BELOW SIDEWALK)
ARMORED CAR
GUARDS
MIRROR
INSPECTION CORRIDOR
DEPOSITORS' BOXES REQUIRING TWO DIFFERENT KEYS TO OPEN
TELEPHONE
ELECTRIC CONTACTS OVER DOOR
CONCRETE
FINISHING PLATE
STEEL WALL
AIR SPACE
UPPER VAULT
INNER DOORS
TIME LOCK
BOLTS SHOT AFTER DOOR IS CLOSED
4 INCH STEEL FLOOR
ELECTRIC WIRING
LIVE STEAM PROJECTORS
OUTER DOORS
REINFORCED CONCRETE PIERS
MOTOR ARRANGEMENT FOR RAISING AND LOWERING PART OF FLOOR TO PERMIT DOOR TO BE OPENED AND CLOSED
TREAD RAISED BEFORE CLOSING OF DOOR
HEAVY SCREEN AND BAR CAGE
DOOR TO LOWER VAULT
SWITCHBOARD OPERATOR TRANSMITTING ALARM SIGNAL TO GUARD STATION
GUARDS ON WAY TO POINT OF ATTACK
SIGNAL CONNECTED WITH OUTSIDE ELECTRIC PROTECTION COMPANY TO BE RUNG EVERY HOUR AT NIGHT BY WATCHMAN
REINFORCED CONCRETE EMPLACEMENT FOR VAULT

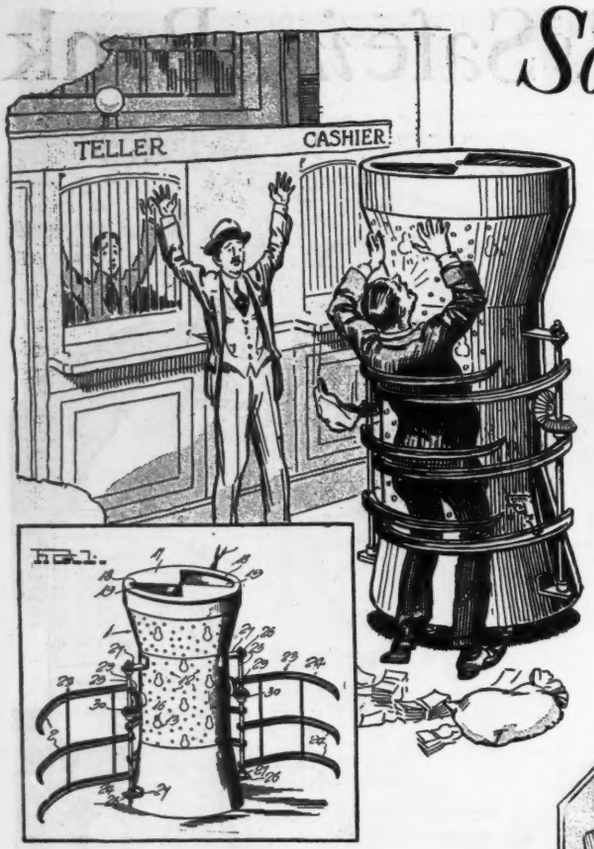
Whenever money is to be transferred to or from the bank, it is transported in heavily armored motor cars manned by machine gunners. The short distance between the car and the bank entrance is heavily guarded

Steel Walls, Secret Alarms and Deadly Defense Appliances Defy Boldest Cracksmen

In repelling any attack of invaders, these great strongholds that safeguard your money offer a triple line of defense. First of all, the vicinity of the vault is patrolled by armed watchmen, guards and detectives. Second, electricity stands always ready as a swift courier to flash an alarm that will summon help in case of attack. And finally, the vault itself is a veritable fortress of special alloy steel which will withstand the most powerful weapons which cracksmen can employ. Tough inner and outer walls, and massive steel doors that are locked and unlocked by two different sets of men, make the repository virtually impregnable. As supplementary precautions, there have been installed such deadly devices as projectors of live steam which, if necessity arose, could turn the interior of the vault into a terrible cauldron where it would be impossible for a human being to survive

Some Queer Ones

Uncle Sam's Records Reveal

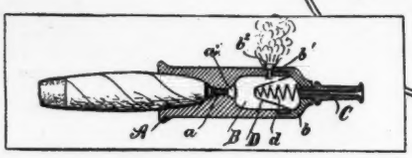


Frightful Trap for Bank Bandits

The armored mechanical monsters of wartime must have furnished the inspiration for this fearful man-catching tank, by means of which "the burglar may be chased, grabbed, and held safely until assistance arrives." It bears the patent number 1,392,095, issued in 1921. Armed with cruel steel talons, and propelled by a storage battery electric motor, it was intended to charge over the bank floor on rubber tired wheels in pursuit of the robber. When the fleeing culprit is within its grasp, a watchman concealed within the sheet metal armor turns a crank. The talons close upon the victim with deadly grip. The watchman then presses an electric button to summon the police. In the metal armor are numerous peep holes through which the occupant may aim and shoot

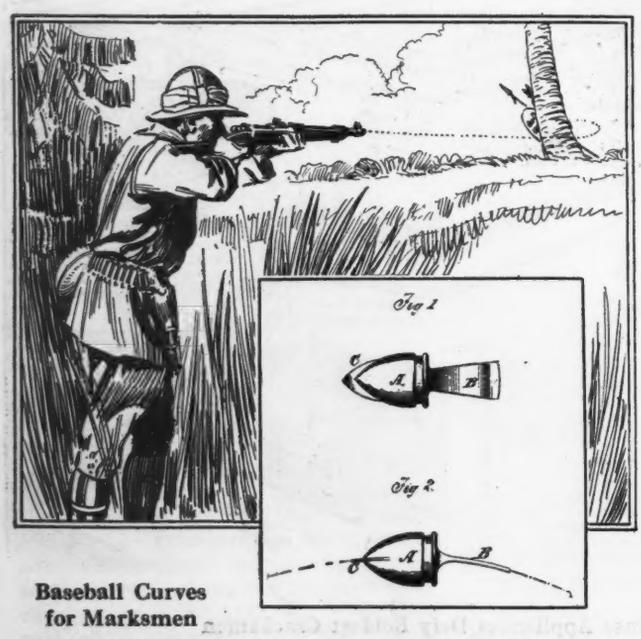
An Expurgated Smoke

Back in 1894 an inventor reached the conclusion that "the principal enjoyment of smoking is in the fragrance of the cigar, and not in the smoke, nicotine and deleterious elements drawn into the mouth." So he devised this ingenious cigar holder to keep smoke from the mouth. Suction on the stem C acts on the diaphragm D, which draws smoke from the cigar into the chamber B. The smoke is discharged through outlet valve b^2



Why Not Eat with Your Feet?

The originator of the ingenious eating machine shown at the left originally intended it as an aid to armless cripples, but suggested also its value to the hurried business man who likes both hands free to read the morning paper. There is a lever with a fork at one end and a weight at the other. The fork end is connected by cable with a treadle. Foot pressure on the treadle plunges the fork into the desired morsel. When the foot is raised, the weight lifts the fork to the mouth of the busy diner

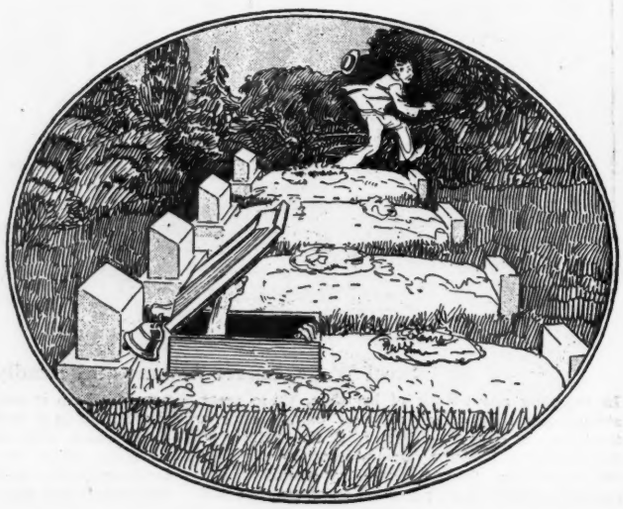


Baseball Curves for Marksmen

The habit of savages of fighting from ambush suggested the idea of a boomerang bullet that would curve and hit a mark behind a tree. Attached at the rear of the bullet (A) is a curved rudder (B), while at the nose of the bullet is a projecting fin (C) set at the same curve. You can see how a marksman of uncommonly keen judgment might learn how to aim wide of his target and hit it

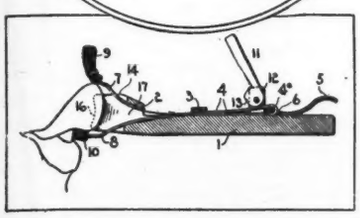
For the Corpse That Doesn't Stay Dead

To allay the terror of being buried alive, Frank Vester patented, in 1868, the elaborate safety coffin pictured below. From the lid of the coffin up to the surface of the grave runs a square exit tube with hinged trapdoor at the top. In the tube is a cord fastened to the bell at the top, and a ladder. Now suppose the deceased comes to life. If strong enough, he can climb the ladder and escape. If too weak to climb the ladder, he can simply pull the cord and ring the bell, sounding an alarm to summon the caretaker of the cemetery to his assistance



from the Patent Office

Many Odd and Unusual Inventions

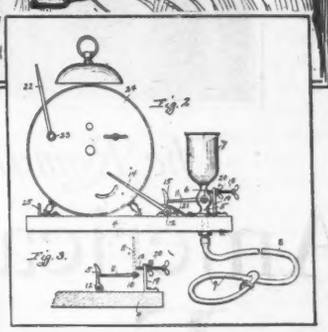


Cute Lips While You Wait

It was early in the present wave of mechanical beauty that a woman perfected this machine to produce the most perfect "Cupid's bow" lips "without resorting to surgical operation." The business end is a clamp of the desired contour. You fasten it to the upper lip by pressing a lever. The longer you keep it there the more alluring is the pucker

A Water Cure for Late Sleepers

Sudden awakeners, such as the patented alarm clock device for hurling the late sleeper out of bed, pictured in last month's issue, were considered too shocking by the originator of the apparatus at the right. He rigged up his alarm to let loose a stream of cold water running from a glass through a perforated tube about the sleeper's neck. The worst possible effects, the inventor figured, would be to give the sleeper a morning bath, and perhaps induce troubled dreams of shipwreck or drowning

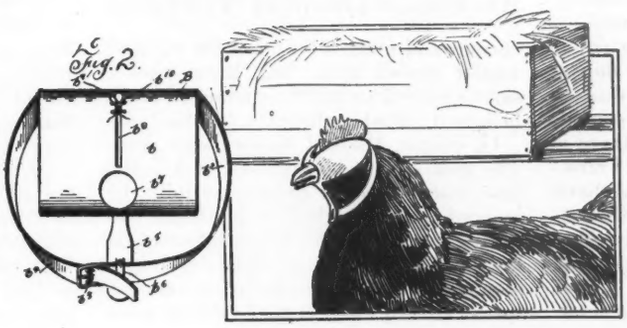


Breath Quenches Thirst

Lurid tales of the shipwrecked sailor's cry for "Water!" evidently stirred a New York inventor who, in 1923, patented a scheme for replenishing the canteen by condensing the sailor's own breath. The idea, shown at the left, was to "subject the human breath of exhalation to condensation, and collect and store the condensate for use as a method of relieving thirst where drinking water is not available"

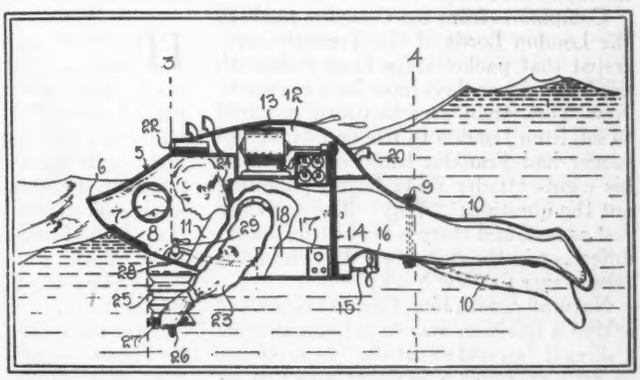
A Mechanical Whip

Possibly the success of the automobile accelerator suggested the idea for a mechanical whip (below) patented in 1914. Here the whip is held in a socket adjacent to the desired point of application, and operated through a chain drive by a lever at the right of the driver. Each pull on the lever brings the whip down. Undoubtedly, it possesses the advantage of pounding at the nag always in the same spot



How Can She Set?

There have been innumerable schemes to keep hens from trying to set, from cooping Biddy in a barred cell to setting her down in a pan of cold water. This invention, though, provides for a blind strapped over the eyes of the old bird so that she can't look upward to find the nest. The patent is shown at the left

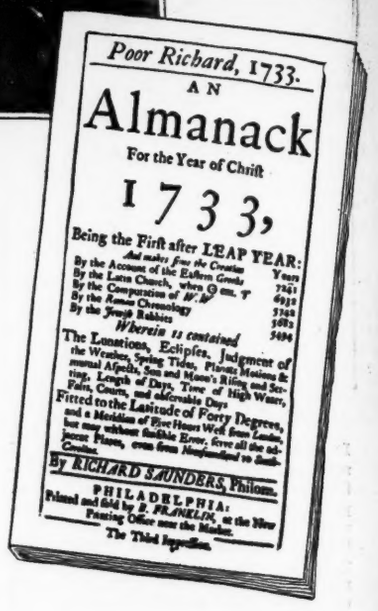


One-Man Submarine Built Like Turtle

A man from Denver, Colorado, invented this one-man submarine in 1918. It is shaped like a turtle, and, the patent papers say, is "substantially in the nature of a diving suit." An electric motor (13) connected with the propeller shaft (15) drives the ship. In submerging, a bellowslike receptacle (25) is collapsed, forcing the air into a tank (18). The legs and arms, inclosed in flexible rubber, can move freely to guide the ship. The hull is fitted with windows (7 and 8) and an electric headlight (22)

Franklin the Printer

This fine print (a Thistle print, copyright the Detroit Publishing Company) shows Franklin at work in his print shop. Below: The title page of Poor Richard's Almanack for 1733, showing much space devoted to scientific subjects


Poor Richard, 1733.

AN

Almanack

For the Year of Christ

1733,

Being the First after LEAP YEAR:

By RICHARD SAUNDERS, Philom.

PHILADELPHIA:

The Romantic Story of Franklin

America's First Great Experimenter

How His Curiosity Put the Gulf Stream on the Map

By
ARCHIBALD DOUGLAS TURNBULL

BENJAMIN FRANKLIN'S face, on our one-cent stamp, is as well-known as "In God We Trust" on our silver money. It is the face, not of one who "launched a thousand ships," but of one who once had a great deal to say in deciding where a lot of ships should, or should not, be sent. In fact, there is good reason for saying that but for Franklin two centuries ago there might have been a considerable difference in the history of New York City as a world port.

He was Postmaster of Philadelphia at the time. Ex-Governor Spottswood of Virginia, as Colonial Postmaster-General, had appointed Franklin his deputy.

Complaints from the Colonies, made to the London Lords of the Treasury, protested that packet ships from Falmouth needed fourteen days more for a voyage to New York than merchantmen required to sail from London to Rhode Island. No sooner had Franklin heard of this, than his eight-cylinder mind began pounding out the question: "Why? The ships are just as fast, and there is very little, if any, difference in the distance. Why should it take longer to New York?"

Naturally, with him, the next step after asking a question was to get the answer. Calling it "an odd situation," he sat down to write everyone who might give him an explanation. Among his correspondents he included some old sea captains and one of these, a Nantucket whaling-man, wrote back promptly.

"There's a current in the ocean," he said. "If you leave Falmouth and want to make New York, you have to cross that current and make allowances for it. Any whaler knows that, but these packet sailors, even if we tell them about it, won't believe it. That's where the trouble lies."

Of course, the old skipper was right. The gulf stream lay across the Atlantic lane where it could not successfully be ignored. Immediately, Franklin began collecting every possible bit of information he could find about it, and also began seeing to it that this information was spread around where it would do the most good.

HE WAS instrumental in having a diagram of the stream and its course made, with the result that it soon appeared upon all Atlantic charts. After he had stood the egg on end, as it were, anybody could crack it. With a proper calculation on the stream, it was a mighty poor navigator who could not cut his running time from England to New York. And New York retained its supremacy in trans-Atlantic shipping over the Rhode Island ports.

To explain the stream, as he had to do for his own satisfaction, Franklin declared that it was due to an accumulation of water on the eastern coast of America, piled up by the trade winds. On some of his own voyages he had noticed a difference in the color of the water, as well as weeds in the stream, which, as he put it, was "warm and did sparkle at night." Moreover, he had put overboard a thermometer and recorded a long series of temperatures, to prove that he was dealing with an independent current. Tracing its course up the coast, he contended, correctly enough, that the warm air of the stream, meeting the colder Newfoundland atmosphere, caused the fogs with which that region was infested.

Altogether, his was a considerable contribution to hydrography. Such interest in the gulf stream is all the more remarkable because, from the time he became Postmaster in 1737, it would seem that he had enough to do with his efforts to hire faster post riders, reduce postage rates, and work as earnestly as he did work to improve the whole mail service.

The truth is that he could never be drawn wholly away from thinking about the sea. As a Boston youngster, when his father, old Josiah, was planning to make him a preacher, he himself was just as determined to run away and "go for a sailor." Just as his father's plan was realized in a sense—since the son did become a practical preceptor of every man's religion—so his own young hopes were fulfilled as far as keeping him always interested in the sea, its phenomena and its mysteries.

ON ONE occasion, when he was afloat with "a fleet of ninety-six sail," he was struck by the fact that two of the ships seemed to be leaving wakes much smoother in appearance than those of the other ships. When he asked about this, he was told by the captain of his own ship that these two ships had just thrown over-

board the greasy water from their galley pots. To a mind like Franklin's, this reply was just suggestive enough to raise the next question, "Well, what does that prove?"

Some years later the incident was brought back to him when he heard that a certain ship, pitching and pounding in a furious sea, had dumped a few gallons of oil overboard to get rid of it.

"What happened?" demanded Franklin.

According to the report, it appeared that the oil had had the surprising effect of smoothing down the angry crests of green rollers and materially easing the struggles of the ship. "Oil on troubled waters" immediately took on a practical significance for Franklin, and off he strode to the nearest lake, a bottle of oil in his capacious coat pocket.

THE breeze was rippling the lake's surface when he arrived. Taking out his bottle, he sprinkled a few drops here and there. As the oil spread, he noticed with delight the prismatic color which was reflected, but he also noted that there could be little doubt of the effect upon the ripples. First from the beach to leeward and then from that to windward, he went on sprinkling. Even under the fresh breeze the oil, spreading sluggishly, wiped out the ripples. The "slick" was perfect.

Proceeding, in his careful way, to make notes of this experiment, Franklin immediately expanded these into a letter in which he maintained that the same effects would be produced on the open ocean. His obvious deduction was that a ship, by using oil, could make an artificial lee for herself. Franklin argued that it would be a simple matter for any ship to carry enough oil, since so little went such a great way, for use in a storm; and that it would be equally simple to dump it overboard through the scuppers.

So delighted was he with his conclusions that he carried a little oil in the hollow of his bamboo cane for a long time afterward. On his walks about the country he would stop at any river or bay to demonstrate for his companions the value of the oil.

Strictly speaking, perhaps, this was not his discovery, but he certainly rediscovered, and, as was his way, proved to his own complete satisfaction the quality of "this friend of the blue-water sailor." What was more—he gave it publicity.

NOWADAYS, not a winter passes without its tales of lifeboat rescues made possible only by the oil slick first spread in a carpet between some liner and a derelict tramp or schooner the crew of which had been clinging for hours to frozen remnants of rigging.

As another means of helping a ship in a heavy seaway, Franklin devised two types of what he called "swimming anchors," now better known as dragues, for the purpose of holding the ship's head to the wind and thus presenting the smallest possible resisting surface.

One of these anchors took the shape to which he was rather partial—that of a kite. The other was more complicated, consisting of a number of ribs "in the form of an umbrella" over which "four-square canvass sail" was to be stretched. Spread open, and attached to the end of a long bowline from the ship, this would offer considerable resistance. To turn or "spill" it, and thus make it easy to haul back on board, it was fitted with a small lanyard. In other words, to all intents and purposes, it was a water parachute.

The three requirements which Franklin listed for these anchors were as follows:

1. Resistance to the sea, sufficient to hold the ship's head "up" or to windward, and causing the anchor itself to drift but slowly to leeward.
2. Must be capable of being placed below the "heave" of the sea, but not below the undertow.
3. Must not take up much room aboard ship and must be easily handled.

Today every patent drague, as well as every hastily improvised one, dropped overboard by a vessel broken down or caught, short of fuel, by a gale, must meet these essentials.

All this, with a number of other proposals, was embodied by Franklin in a long letter to M. Le Roy, a friend in Paris. Speaking of the attention which had been paid to the form of hulls, or "stream lines," he suggested similar attention to the cut of sails, in order that they might offer a minimum resistance to head winds. On the theory of smaller sails and more of them, he drew his design of a rather extraordinary rig, vaguely suggesting what is now called the "sliding Gunter" and used for ship's cutters.

IN A letter he made a sketch of the manner in which a ship's hemp cable could be parted because of the heavy strain resulting from a right-angled bend or "elbow," and suggested as a remedy a pulley wheel in the hawse pipe.

To M. Le Roy, Franklin voiced the opinion that the crews of leaking ships might often do better by staying aboard their craft than by embarking in small boats only to lose their lives in an effort to reach a distant shore. He maintained that although the entering water might at first gain too rapidly upon the pumps, the point would be reached shortly where the level inside was the same as that outside. Then the pumps should be able to maintain this level, while casks, chests, and light upper woodwork would help keep the ship afloat, even though awash, until aid might arrive.

Still other ideas in the letter dealt with the paddle wheel. Too much of the power was wasted, thought Franklin, due to the loss of really useful work in the up and the down parts of the stroke. He judged it would be better to propel a boat by picking up a stream of water from under her keel and pumping it out again at her stern.

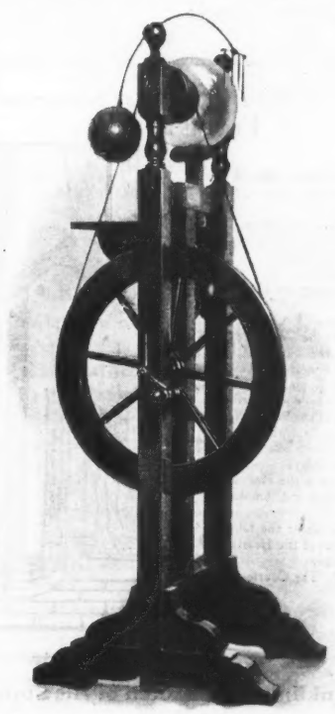
As a matter of fact, some years later, when experiments with steam engines became common, this plan of Franklin's was given a trial—for example, in the engine designed in 1798 by the celebrated Chancellor Robert R. Livingston, of New York. That particular engine racked its boat to pieces.

THIS same long letter also discussed methods of hauling boats ashore through surf, suggested special forms for the ship's planking, and even included designs for curious "soup dishes" which could be depended upon not to overturn in rolling weather. Water-tight compartments, first invented by the ever-resourceful Chinese, are mentioned and approved. Perhaps most of these things do not represent any vital contribution to the science of seamanship; nevertheless, this letter is an excellent sample of Franklin's ingenuity and of his inexhaustible interest in maritime improvements.

When Franklin again went to London, this time as the accredited representative of Pennsylvania, he was not the humble fellow of his first visit, but a personage. His close friends were such men as Priestley, the discoverer of oxygen, and William Strahan, the rich publisher who was also a friend of Doctor Johnson. In

If Franklin Were Alive Today

OF ALL the Colonial fathers—Jefferson, Adams, even Washington—none of them would find himself so completely at home in our times, if he could come to life again, as always-inquisitive old Ben Franklin. He is distinctly of our own day, as Mr. Turnbull's fascinating serial romance serves again to show. This is the second installment of this four-part story; the third will appear in next month's issue.



Electrical machine, still in existence, used in Franklin's experiments two centuries ago

the five years of his mission he made many experiments, one of which was designed to prove that a ship moves faster in deep than in shallow water.

He built a wooden trough, fitted with a false bottom which made it possible to regulate the depth of water in the trough at will. Attaching a string to a boat model, he carried the other end over a pulley and made it fast to a silver shilling as towing engine. The falling shilling dragged the boat more swiftly when the water was deeper. In this simple way, he established the truth of this great natural law, which seems to have been neglected by all previous works on science.

Types of the Famous Franklin Stove

Because Franklin didn't like smoky rooms—and Colonial homes in winter were veritable smoke boxes—he invented a stove which heated the room evenly and carried smoke away. It was a revolutionary idea, and was adapted to many types of stoves

SUCH everyday object lessons, such demonstrations as could readily be duplicated with practically no scientific apparatus by anyone in his own home, gave Franklin the widest appeal. It is safe to say that, in all history, he was "the first great popular scientist." Although, strangely enough, he never wrote a book on science, he could easily have done it, if his many other activities had not consumed so much time.

Take, for example, his study of waterspouts. The first time his eye met one of these, he thrilled to its spectacular beauty just as anyone who ever sees one must thrill. Then there popped into his head the inevitable question, "What causes it?" As usual, his ferret mind, once loosed upon this trail, would not leave it until it had dug out its rat in the form of a satisfactory answer.

He had already thought about whirlwinds ashore, and so he was not long in establishing an analogy. "Both whirlwinds and waterspouts," he wrote, "occur most frequently in the daytime, after periods of great heat when the air had been free from winds. Both, in motion, are rotary as well as progressive." Again, he had noticed that, from the space surrounding a whirlwind, the wind blows *in* toward the whirl from all directions.

ON INQUIRING among his sea captain friends, they told him that they had experienced this same thing with spouts. Finally, if a spout, through its progressive motion, left the sea, it acted exactly like a whirlwind over land. Having made elaborate drawings to illustrate his observations and deductions, Franklin announced his conclusion that the two are identical manifestations, produced under different circumstances. In this, later scientists have supported him.

Franklin's well-trained fingers were always itching to build something. His distaste for the smoke-laden rooms of the time finally gave them an opportunity to show what they could do.

At that time, there was little scientific knowledge of open fireplaces. The "Holland" stoves of the day afforded almost no ventilation, and the "German" type was simply an iron box. Therefore, it remained for Franklin to produce the "Pennsylvania fireplace" or, as it became popularly known, the Franklin stove.

Doubtless he merely applied the same principle he had encountered in his study of storms over areas of changing pressure and rarefied or "thickened" atmosphere. Hot air, of course, must rise, and he constructed his fireplace to obtain from this the best result.

HIS stove included special bottom plates, top plates, side plates, and "two middle plates which, joined together, form a tight box with winding passages for warming air." A false back of brickwork was built into the chimney. Then, as the warm air rose, it was prevented from going up the chimney by this false back. It passed, therefore, into the room and up to the ceiling, its place being taken by fresh, cool air.

PROFILE of the Chimney and FIRE-PLACE.
M The Mantle-piece or Breaſt of the Chimney.
C The Funnel.
B The falſe Back & Cloſing.
E True Back of the Chimney.
T Top of the Fire-place.
F The Front of it.
A The Place where the Fire is made.
D The Air-Box.
K The Hole in the Side-plate, thro' which the warm'd Air is diſcharg'd out of the Air-Box into the Room.
H The Hollow fill'd with freſh Air, entring at the Paſſage I, and aſcending into the Air-Box thro' the Air-hole in the Bottom-plate neat
G The Partition in the Hollow to keep the Air and Smoke apart.
P The Paſſage under the falſe Back and Part of the Hearth for the Smoke.
The Courſe of the Smoke.
M
C
B
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I

Franklin's Own Sketch of His Stove

A false back was the feature of Franklin's fireplace. The warmed air rose but, prevented from going up the chimney by this back, passed into the room, being replaced by fresh air. Smoke, on the other hand, passed unhindered up the chimney

Thus the whole room was warmed, with the advantages, as claimed by Franklin, that the temperature was even, with "no cold drafts, so uncomforting to the back, and a result ideal for invalids. In rooms where much smoking of tobacco is done," he adds, "it is advisable to cut a small hole, five or six inches square, in the stove funnel, which, when fitted with a movable plate, will carry off the smoke."

History, of course, relates that he refused to take out any patent protection for this invention, although he was strongly advised to do so. He dismissed the advice with a Golden Rule gesture: "Since we profit so largely by the genius dwelling in the minds of others, we should be ready and willing to give them the fruits of our own minds."

IN A sense, this instance of an uncommercial point of view is not wholly consistent with the picture of a frugal Franklin which has come down to us. It cost him something, for it promptly resulted in the copying of his plan by an Englishman who read Franklin's widely published description, built similar "Pennsylvania fireplaces," and made a pretty penny out of them. But Franklin, hearing of this, merely smiled. Ideas, with him, were the easiest and cheapest things in the world to produce.

He always kept up his interest in ventilation and kindred subjects, in which he gained a reputation as an expert. To one seeker for information, he wrote: "If you will but let me have the complete description of your room, its situation and connexion, possibly I may form a better judgment of how to get rid of the objectionable smoke."

VENTILATION suggested interesting ideas in hygiene and medicine Believing that the human body breathes through its pores, he proposed to give it this opportunity by walking naked about his room with the windows wide open to the night air. He made copious notes upon the inception and treatment of colds. He wrote a series of questions, asking whether this or that would bring about the affliction, and then proceeded to answer them himself. Thus: "By putting a damp shirt on a dry body? Yes. By putting a dry shirt on a wet body? No, though this wet the shirt ten times more." People, he declared, think that they catch colds by coming out of heated rooms into the fresh outdoors, whereas they really get them by being in such places.

Exercise, he declared, would cure a cold, while other remedies (*Continued on page 150*)

How *to* See *That* Your Oil Burner *Is* Properly Installed

You can check up on it yourself if you follow these pointers, laid down by an expert—What service means to you

By P. E. Fansler

NOT even a perfect oil burner will give you heating comfort in your home unless it is properly installed and unless the dealer from whom you purchased it stands ready at all times to give you prompt and adequate service.

As a home owner, therefore, you are confronted with two equally important problems. You must pick out a good oil burner, and you must make sure that the burner will be properly installed and serviced.

Even in these days of highly perfected automobiles, you would hesitate about buying a car from a dealer located so far away that you could not expect to get service if anything went wrong. The car might not give any trouble at all for a long time; yet you would always have the feeling that even a slight difficulty would be a serious matter just because the dealer wasn't within easy reach.

And the oil burner should be classed with the automobile as far as service is concerned, although the oil burner actually ranks considerably higher from the standpoint of long-continued operation without attention.

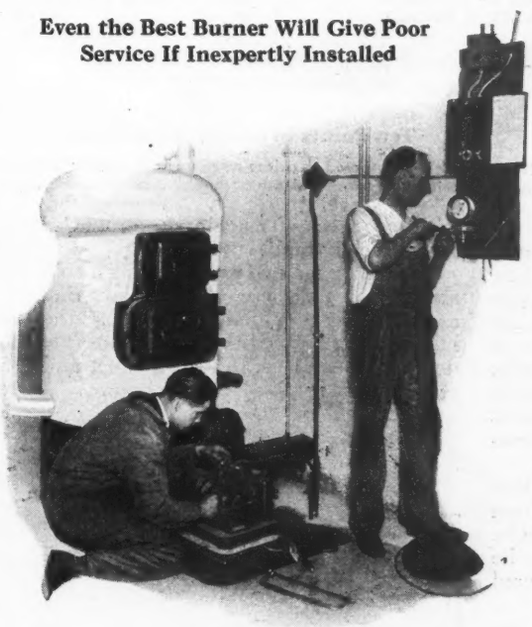
That means, of course, that you must investigate the standing of the dealer as well as the reputation of the oil burner he sells. While there are a number of satisfactory makes of oil burners, your choice may be limited to one or two simply because they happen to be the only ones that are adequately represented in your neighborhood. Sales and service stations for all the popular makes of automobiles are now scattered all over the country in almost every village, but, while the oil burner makers are bending every effort to increase their lists of reliable dealers, there are still sections where there are no dealers at all and others where only one make is represented.

Let the salesman explain the merits of the burner he is selling. Get him to go into full details about its operation. He will want to know what kind of a heating plant you have in your home, and before he will quote you a price he undoubtedly will have the company's heating engineer come around and make a survey of the conditions under which the burner will have to operate.

ASK him for a list of customers using his burner in your neighborhood. It will be well worth while to talk with as many of them as possible, getting the opinions of actual users of the burner as to its efficiency and reliability. Get a line on the number of service calls each home owner has had to make, and the speed with which the service man appeared on the scene.

Find out how long each burner has been in service and, if some of the older burners are in operation at the time you make your call, notice the amount of noise produced as compared with the demonstration burner in the agent's showroom.

Even the Best Burner Will Give Poor Service If Inexpertly Installed



Slipshod piping and loose boiler and flue joints may cause an oil smell, and careless electrical work may cost much later. For these reasons, be sure to select a reliable dealer who will make a satisfactory installation as shown above

Of course the slight rushing noise produced by the burning oil will be the same no matter how old the burner is, but a marked increase in the motor noise would indicate either that the motor was wearing rapidly or that the owner had not lubricated it often enough.

Question each owner on the subject of economy so that, comparing the size of your house with his, you will be able to approximate the probable cost of heating your own home.

In questioning oil burner owners about fuel costs, try to get information that covers at least one whole winter season. It is unfair to compare the consumption of oil during October, for instance, with the average amount of coal burned during each month of the previous year, simply because the consumption of fuel in any home starts low in the fall, rises to a peak during the coldest winter months, and then falls off again as spring approaches.

Notice, also, the size and location of the fuel tank in each of the installations.

A large tank has the advantage of permitting you to buy your oil in large quantities, lessening the chance of running out of fuel during a long cold snap when the roads are blocked with snow. Companies selling oil usually sign contracts in the spring or summer, guaranteeing the price for a year. Naturally, if you have a 1,000 or a 1,500-gallon tank and can take delivery in "tank wagon lots" of 600 to 1,000 gallons, you can get a better price because it costs less to deliver these "lots" that do not have to be hand-measured.

You may easily save enough by buying in "wagon lots" to save, in three or four years, the excess cost of a large buried tank over a small basement tank.

THE fumes produced by burning oil carry the characteristic oily odor regardless of the type of burner, but this smell cannot get into your house if the boiler and flue joints are absolutely tight.

A slight leak in the flue between the check draft damper and the chimney will not ordinarily allow coal gas to get into your house when you are burning coal, because the natural draft of the chimney causes air to be drawn into the leaky joint of the flue pipe. The mechanical draft type oil burner forces air into the fire chamber without regard to the natural draft. Unless there is a strong natural draft developed in your chimney, the forced draft from the burner may overcome the slight vacuum in the flue and create a low pressure instead. It is this possibility that explains the need for absolutely tight flue pipe connections.

IT WILL be necessary to make sure that your chimney is in perfect shape and that there are no openings through which gases could get into your home. And if the men who make the installation are competent they will examine the inside of the chimney and make sure that it is not clogged up with soot and ashes which have accumulated from the burning of coal.

When properly adjusted, the modern type of oil burner produces a flame that is practically free from smoke or soot, so if you have heard of anyone who has experienced trouble with soot clogging up the chimney, you can be sure that the oil burner was set for too rich a mixture. In other words, the air supply was too

limited for the amount of oil that was being fed into the combustion chamber. Everyone who has had occasion to regulate the wick on a kerosene lamp or stove knows that, if you turn the wick up too far, smoke will be produced. A lamp operating with the wick too high exactly parallels the case of an oil burner that is feeding too rich a mixture.

The only other possible chance for oil smell is from the actual leakage of oil fuel out of the piping or the burner. The manufacturers take great pains to make the joints in the burner absolutely oil tight, but trouble may occur if the pipe installation is done carelessly or with poor tools. Piping done in a slipshod fashion may hold oil for some time, but is sure to spring a leak sooner or later.

AS FOR the electric wiring, a good workman will solder and tape the connections so that no trouble can develop from this source. The thermostat is part of the electric control circuit, and while its installation consists merely of screwing it to the wall and running wires from it to the control box near the oil burner, the location of the thermostat is vitally important.

The arrangement of the rooms will determine the best position for the thermostat. Because it must be made sensitive to slight changes in temperature in order to respond with great promptness to variations in the room, it should not be hung where the opening of a door or window will blow cold air directly on it. The result of installing the instrument in such a location would be the frequent starting up of the oil burner unnecessarily.

Usually the best place for the thermostat is in the living room as far from the doors and windows as possible. In other homes the temperature may be more uniform in the dining room. Avoid drafty halls and stair landings.

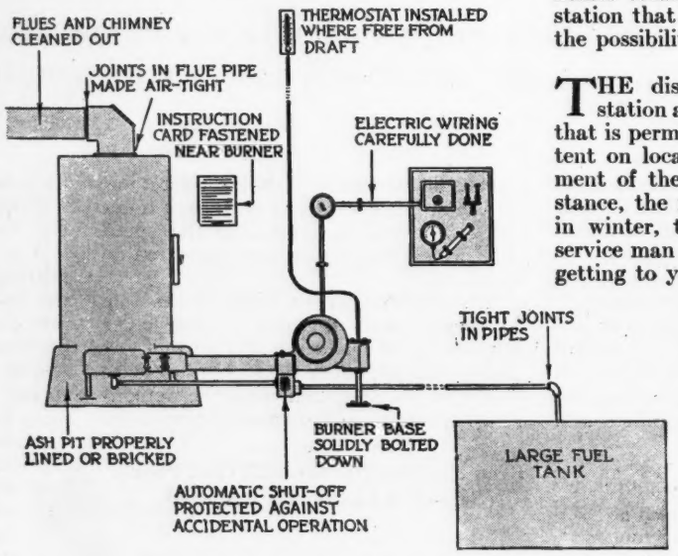
Too much noise and vibration occasionally are the result of defective support for the moving parts of the burner. The base on which the blower and motor are mounted should be of solid construction, and the frame of the burner should be bolted tightly on the base.

All types of mechanical draft oil burners are fitted with automatic shut-off devices so that the burner will be stopped and the oil supply shut off if anything goes wrong. These devices should be protected to prevent accidental shut-offs if someone unwittingly brushes against the apparatus. Many calls for the service man have been caused by the tripping of the automatic shut-off by a pet dog or cat.

INSTRUCTION cards showing how to start up the burner in the fall and the precautions to be observed when turning it off in the spring, with other necessary details about the care of the apparatus and the oiling of the motor, are supplied by the manufacturer. This card should be permanently fastened to the wall near the oil burner.

A high grade oil burner correctly installed will insure you heating comfort only when it is backed up by the right kind of service. It is quite true that there are records of oil burners that have operated perfectly for three years or more without any attention from the service man. At the same time it must be remembered that breakdowns are possible with any piece of machinery, no matter how perfectly built.

Something may go wrong during a cold snap, when the thermometer is hovering around the zero mark. Getting the burner going again with the least possible delay is imperative at such a time, and service must be obtainable at once.


FLUES AND CHIMNEY CLEANED OUT
JOINTS IN FLUE PIPE MADE AIR-TIGHT
INSTRUCTION CARD FASTENED NEAR BURNER
THERMOSTAT INSTALLED WHERE FREE FROM DRAFT
ELECTRIC WIRING CAREFULLY DONE
TIGHT JOINTS IN PIPES
ASH PIT PROPERLY LINED OR BRICKED
BURNER BASE SOLIDLY BOLTED DOWN
AUTOMATIC SHUT-OFF PROTECTED AGAINST ACCIDENTAL OPERATION
LARGE FUEL TANK

Ten Points in a Good Installation

If you check up on these ten points when your oil burner is installed, you may be saving yourself considerable trouble, annoyance and expense later

Reliable oil burner manufacturers and dealers recognize the need for good service, and make a point of having expert service men available at all times. They also keep a complete stock of spare parts on hand. As a general rule, the reputable oil burner dealer does not attempt to sell or install oil burners in homes located so far from the service station that there will be a doubt about the possibility of quick service.

THE distance between the service station and the oil burner installation that is permissible depends to a large extent on local conditions and the equipment of the service station. If, for instance, the roads are almost impassable in winter, then it is obvious that the service man is going to have a hard time getting to your house if you are located thirty or forty miles away.

Stressing the importance of good service should not by any means convey the impression that oil burners are balky, unreliable pieces of apparatus that require constant attention. That is certainly not true. Mechanical draft oil burners of approved types are just as reliable as the finest kinds of automatic machinery in other lines, but the need for prompt service in the case of the oil burner is emphasized by the important work it performs in giving you continuous heating comfort.

And the records of the oil burner service stations show that a great many calls for service are unnecessary. The most frequent call of this type comes from the woman who suddenly discovers that her house is getting cold because the oil burner is not operating. Without making any investigation at all, she phones for the service man, and the latter rushes around to the house on the double-quick only to find that the oil supply tank is empty.

ANOTHER call is from the home where a fuse has blown in the electric supply line. Troubles like this obviously cannot be blamed on the oil burner, but they do call attention to the fact that the owner of a heating plant operating on liquid fuel will find it worth while to familiarize himself with the more important features of his equipment.

Most dealers in oil burners make sales with the definite understanding that service of all kinds is to be without charge for a certain length of time. But no oil burner is sold without a time limit on the free service agreement, and after that period expires you will be expected to pay a service charge for each visit of the repair man. If a fuse blows out and you call the service man around to fix it, you will have to pay a fixed charge amounting to two or three dollars just to replace a fuse that may not cost more than ten cents. During the period when service is free, you should do your best to become familiar with the simpler troubles that may come up, so that when the free service period expires you will be prepared to take care of all simple matters yourself.

Help in Selecting Your Burner

THE engineers of the Popular Science Institute of Standards are ready to help you solve your oil burner problems.

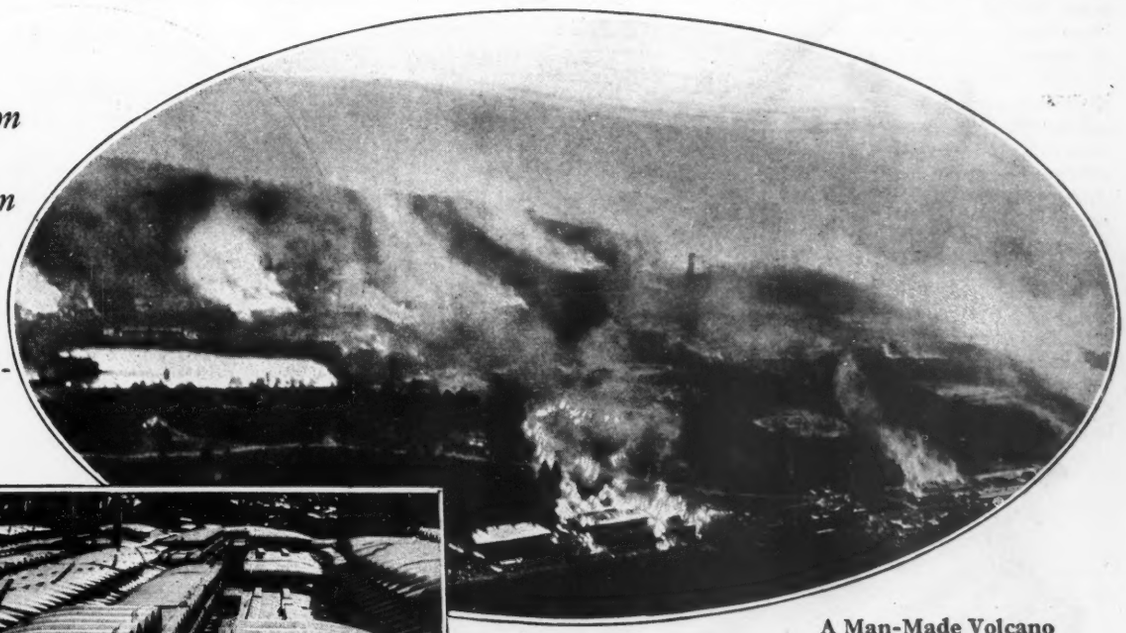
The Institute has undertaken, in conjunction with The Heating and Ventilating Magazine, a nation-wide survey to determine the efficiency of the several oil burners.

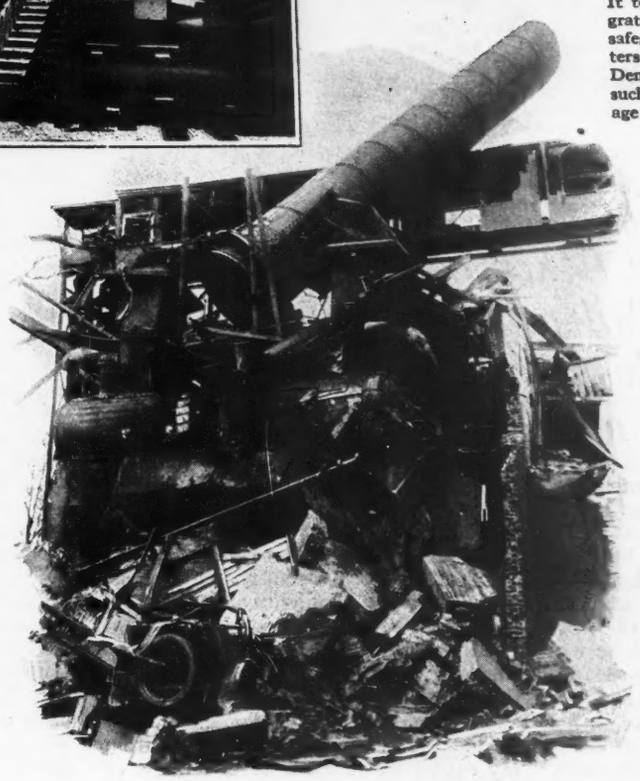
This survey is the most elaborate of its kind ever made. Oil burners in homes in every part of the United States are being inspected and detailed reports are being compiled on the results of the various types.

For information about oil-burning equipment for your home, write to Popular Science Institute of Standards, 250 Fourth Avenue, New York City. A chart has just been prepared that will assist you in solving your problem. Ask for it!

Warding *Lightning* from Arsenals

Can Munition Depots Be Protected from Death-Dealing Bolts?—Recent Blast Starts Controversy





A Man-Made Volcano Breaks Loose

It took a lightning bolt to start this conflagration. Government arsenals are rigidly safeguarded against fire, but lightning arresters proved powerless to prevent the Lake Denmark disaster, pictured above. Can such blasts be prevented?—Below: Wreckage of the power plant. Left: Stored shells

EXPERTS had taken every humanly possible precaution, so they thought, to safeguard the twenty-one Government munition depots where our Army and Navy store some two billion dollars' worth of explosives.

And then, without warning, at the height of a storm one afternoon recently, the clouds let loose a livid lightning bolt and hurled it upon the great munition station at Lake Denmark, New Jersey. One bolt snuffed out more than a score of lives and destroyed more than $80,000,000 worth of property.

The unforeseen and unexpected had happened.

Naval authorities, in the face of criticism, reminded the public that it was the first disaster of the kind in our history, and that every available means known to science had been employed to minimize the danger of such a tragedy.

Some experts asserted there was no sure way of preventing the danger from lightning.

And still there persists the question: How can a repetition of the Lake Denmark disaster be prevented in the future?

Among scientists who insist there is a practical way to assure absolute protection against lightning is Professor Michael I. Pupin, of Columbia University, one of the world's foremost electrical experts.

The scientific lightning protector urged by Professor Pupin consists of the use of grounded copper sheeting for roofs and walls.

"Suppose," he says, "you have a house and want it protected from lightning. Put on a copper roof, protect the chimneys with copper sheeting, and then connect the roof at numerous points by copper rods with the ground. The rods must go deep into the ground until you strike wet soil. Cover the sides of the house with copper sheeting or other metal, which must also be connected with the wet ground. This will keep out lightning.

"All structures where explosives are kept should be constructed in that way."

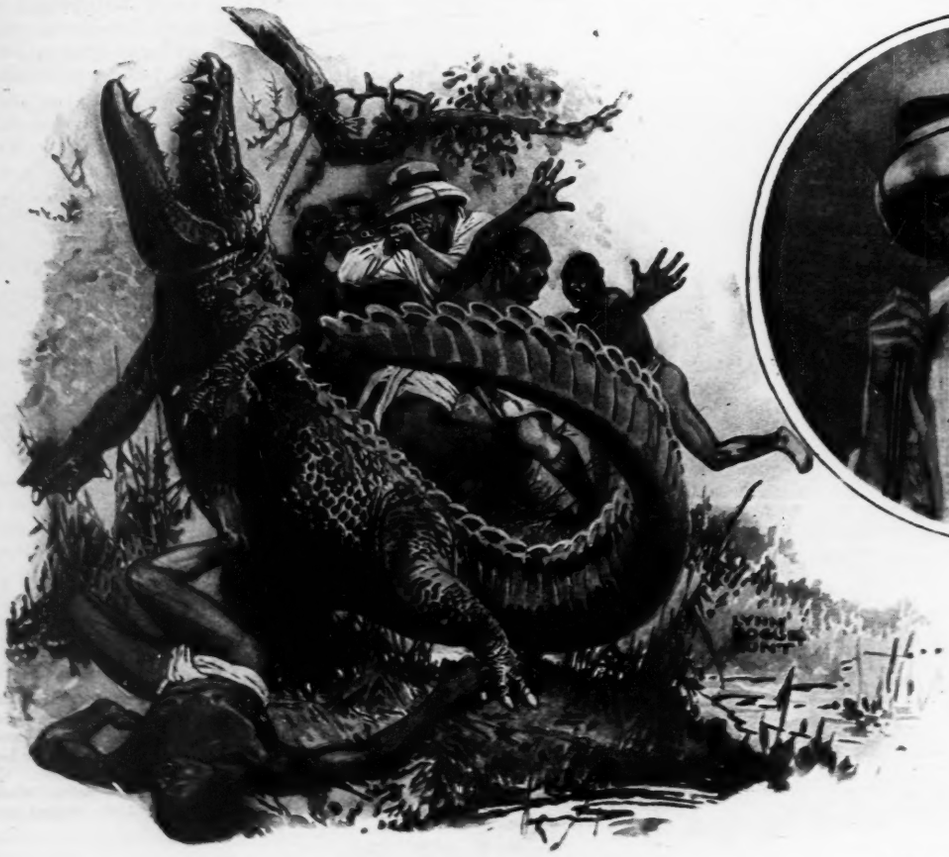
Professor Pupin also points to the fact that the Woolworth building and the Park Row building in New York City, the highest buildings in their vicinity, never have been struck by lightning, while other buildings near them have been struck often. The roofs of these two buildings are covered with copper, conductively connected to the steel girders of the buildings and to the ground.

"BUILDINGS for the storage of explosives should be of steel," says Professor Pupin, "and all windows and door openings copper-screened."

In general, the Government's method of constructing storage magazines has depended on the type of ammunition to be stored. For TNT and other high explosives, which are more subject to fire than to concussion, the buildings have been made fireproof with walls of hollow tile and gypsum slab roofing. Such explosives as black powder, dynamite, tetryl and dry picric acid, in which the danger of detonation is great, are stored behind bullet-proof tile walls filled with sand, with gypsum and slab roofings.

To guard against fire, the magazines are spaced three hundred feet apart, and all underbrush is cleared away. The protection against lightning thus far has consisted of lightning arresters.

My Life Wasn't Worth a Dime—



He Takes Them Alive

Many of the wild creatures we see in zoological gardens and circuses have been brought to us through the thrilling adventures of J. L. Buck (above), famous African hunter, who trails big game in jungles, not to kill it, but to capture it alive. At the left: a spectacular encounter with a great crocodile, from which Mr. Buck barely escaped, and which lashed a native boy to death with its massive tail

When a Giant Chimpanzee Crushed Me in a Death Hug, or When a Huge Crocodile Flung His Tail at Me—Some Other Strange Adventures in the Jungle

By J. L. Buck

A MONSTROUS black chimpanzee, rearing fully five feet high out of the tall saw grass; a great beast that had never looked on man before—white or black. That was what I saw, in the second I faced him, there at Cape Mount in the Vey Country of West Africa; and I realized, too, that he was the largest "babboo" I had ever seen.

He was balanced on his rear legs, his great jaws parted in what looked to me like a terrible grin. Then he lifted his arms—powerful as steam shovels—and, coming at me, flailed the thick grass as he came, crying out hoarsely "hoo—hoooo!"

To shoot at such close range was useless. I saw the yellow of his eyes, and one sentence beat across my mind—"Sally Buck," was the sentence, "Sally Buck, my wife, you'll be a widow tonight!"

The next instant we had grappled. We went rolling downhill, while the grisly thought pounded over and over in my brain. In a moment more his great arms would be crushing me against his ribs.

And then—

I saw a net snap about his sprawling limbs. A second more, and he had rolled himself into it, a ten-yard chimpanzee net one of my faithful boys had thrown.

But his hold was yet on my ankle. I saw him struggle to break through the tough liana net, my foot still in his grip. I watched one of his mighty arms break out of the net. That monstrous embrace—I tried to get to my feet, when between us, breaking the chimpanzee's hold on me, darted a black boy, mad with terror, pursued by a half-grown chimpanzee. He trod on the feet of the old male, and from my captor was torn a howl of rage, of devastated dignity. He released his hold and I fell back, unconscious.

"SALLY BUCK," I whispered, as I came to, "Sally Buck, my wife, you've got a chance—tonight—of not becoming a widow." I had awakened to find—but let me tell first about the beginning of that chimpanzee hunt.

I'd gone up to Cape Mount, in West Africa, after an especially rare and healthy species of chimpanzee said to inhabit that trackless mountain. The morning of the sixth day, as my twenty boys and I wound down a lean ravine between two steep hills, we heard a savage baying ahead of us, to the left. It was a great male chimpanzee. I followed, motioning the boys to have the nets all ready to throw.

I had hardly spoken when a second bass cry of another big male sounded from the opposite hill, which helped shut in our sloping ravine. Then the signaling started. First one old fellow "hoo-hooed" and then the other. They were either comparing notes as to us, the intruders, or they were hurling scathing insults at each other. Anyway, they were mighty angry. But I wasn't alarmed, since my boys were well-trained and my elephant gun was in my hand.

Meantime, they had decided to play hide and seek with us. They kept traveling ahead, hidden by the tall grass, roaring and advancing as we followed, but always keeping hidden. I knew, of course, they were on all fours, as this is the way they travel. I was in the lead. At my heels were my carriers, one boy with a Winchester, others with nets all ready to throw. The boys shouted encouragement to each other. The two big male chimpanzees roared incessantly, and behind, adding to the bedlam, came the village witch doctor, beating on his native drums. Then, out of the turmoil, just twenty feet ahead, the big fellow stood up on his hind legs and made for me!

I'VE already told how we rolled to the bottom of the gully, and how the fear-crazed boy shot between us, surprising the old hairy fellow into letting go his grip on me. Just as I fainted, I tried to shout, "Lefit! Lefit, me boy, lefit!" which in African pidgin means "stop—

let go—don't run, don't show you are afraid!" To show fear with a chimpanzee, or with any wild animal, is certain death.

In the moment that I passed out, the great male broke through the net. Nine times out of ten that would have been the last of me. A few cruel jabs of his powerful rear paws would have been my finish. But the boy and the other chimpanzee diverted the old fellow, and he ran like a shot after the pair, as my servant, Momadu, told me afterward. Down the ravine the entire hunt thudded, apes and boys. When I came to, I got up and hobbled after them. Ten minutes of traveling told me the story.

That younger chimpanzee had chased the frightened black boy right over the precipice to his death!

It is such adventures as this that have caused the neighbors' children in my home town of Camden, New Jersey, to nick-name me "Wild Animal Man Buck." There are thrills a-plenty in the job of wild animal hunting. And there's more satisfaction too, in taking an animal alive than shooting him down before he has a sporting chance to display the ingenuity that's in him.

OF all the animals I catch alive to bring home and sell to American zoological gardens and circuses, the great apes have fascinated me more than any others. Of these, the chimpanzee comes first. There's something so human about these remote cousins of man.

We catch them in traps, with huge nets thrown out to tangle them, in straight, hand to hand raids—though these are extremely dangerous—and with a particular kind of spring trap I myself devised last year.

This is an adaptation of a similar trap American hunters use for taking alive large wild animals. It is entered by a door that falls down when a spring is released. The inquisitive chimpanzee—and these apes are more curious than any old woman you ever saw—sniffs about the trap and spies the fine bunch of bananas tied inside to the rope that controls the spring. Old ones may sometimes hesitate, but curiosity and greed finally will persuade almost any chimpanzee to step inside. One bite at the fruit and down goes the door. Then our task is to persuade a very indignant ape—who plainly knows a trick has been played upon him—out of the trap and into a cage that is carried by the men hundreds of miles to port and the ship home.

I USE the raid when I have sure knowledge a band of chimpanzees will be at a certain spot at a certain time. My boys and I hide in trees, behind trees, and under cover of rocks or mounds. Sometimes we all arise at a signal and fall upon the apes with bare hands, while they are eating. Sometimes we wait until night, and shake the sleeping animals from trees into nets. The method depends on the number of boys at your disposal and the size and ferocity of the species of chimpanzee you are hunting.

I am constantly amazed, old animal man that I am, by the astounding likeness of these animals to men. I have handled hundreds of chimpanzees, and each has had a different nature, and for each I could find some counterpart among my human acquaintances.

I've handled chimpanzees who were born tricksters; I've had females who were born coquettes; I've had them so clever I could teach them to eat with spoon and knife and fork in a few days. Again, I've sometimes come across an ape so stupid that I could never teach him even the use of a spoon. These beasts differ in temperament as widely as do men.

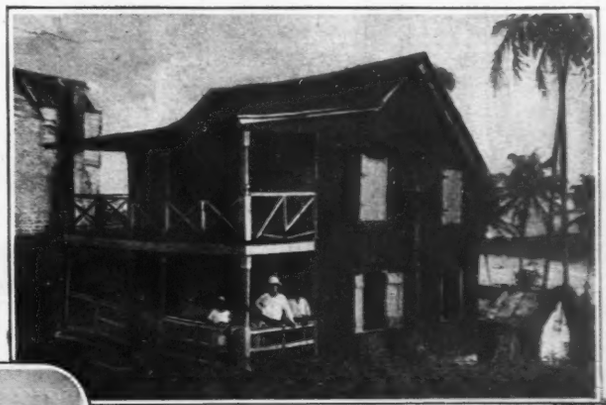
I could write volumes about my experiences with chimpanzees, but probably my readers would prefer to hear about a big, handsome rock python that well-nigh equaled the male chimpanzee in providing me with a cold thrill.

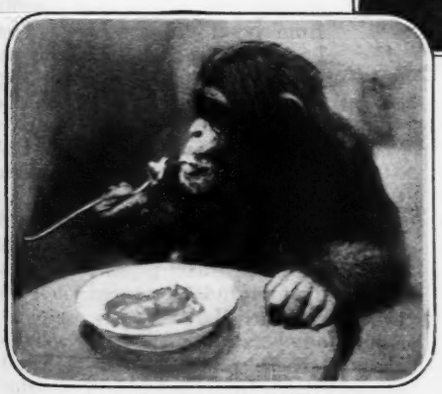
We'd come upon a great rock python in the Vey Country. My boy, Momadu, spied him down a large, wide crevasse. The best way to catch a rock python is to drop a live goat down into his retreat. He'll eat it and then lie torpid for hours. In this torpid state, there's not much more work taking him than just to catch hold and carry him off. But we couldn't do this here, since there was no village to buy a goat. Had we killed a wild antelope he would probably have rejected it, since snakes prefer to kill their own meat. I decided to build a runway along which we could prod him into the opened end of a cage.

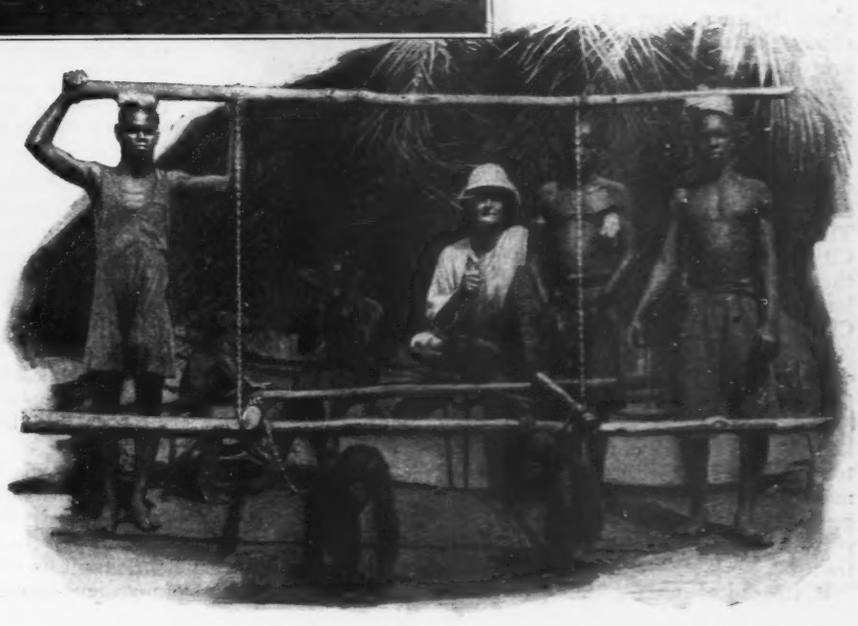
THE runway built, Momadu got into the hole and started pushing the python toward the cage. But no sooner did the python feel the gentle jab of Momadu's stave than he started to rear up. He was twenty feet long, about 200 pounds heavy. He flopped and hissed and pounded against the runway. Momadu whistled through his teeth to bewilder the snake. I yelled down directions. For a few stubborn feet the hissing snake gave ground. Then something went wrong. A swift flapping, a whirl of dry dirt—the frantic cry of the boy in the hole.

I leaped to the edge. The python had broken through the roof of the runway and was facing me, coiled, primed to strike and constrict! His dull, meaningless little eyes were set for me! A great dry heat broke over me, then a weak dampness. The boys howled, I wanted to move, but I couldn't budge. Some sort of hunters' paralysis I had often heard about had seized me.

He was coming toward me, hissing as he came. And then, as he spun through the air, a machete, (*Continued on page 156*)

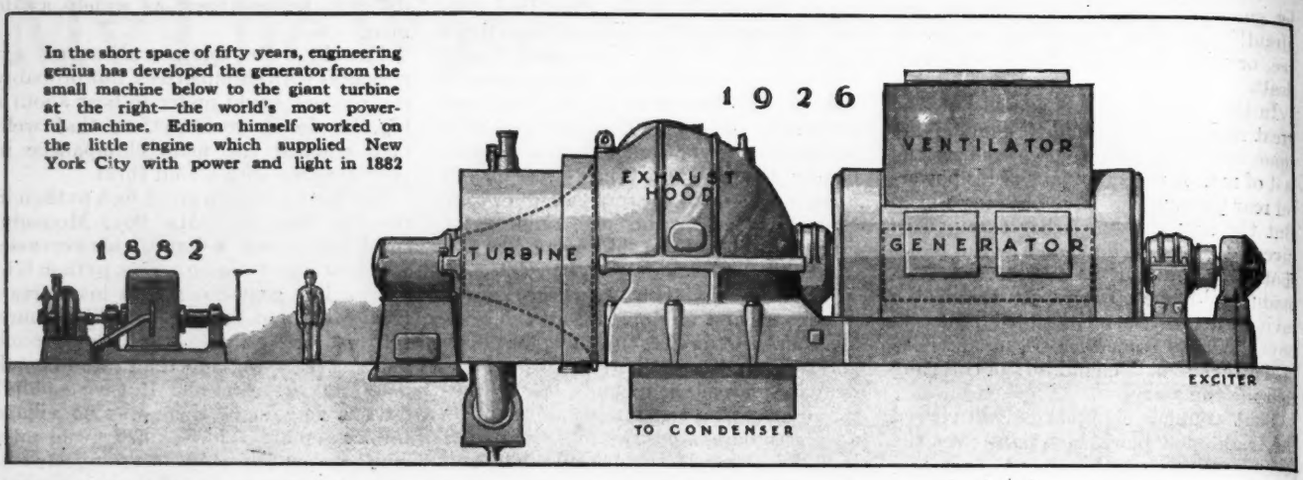






"No Man Can Ever Tire of Wild Animals"

Of all the animals Buck captures and brings to our zoos, the apes fascinate him most. Some are so clever he can teach them to eat with spoons and knives and forks in a few days. Others are too stupid to learn even the use of the spoon. He catches them with traps and nets. Right: Buck and his helpers equipped for a monkey-trapping expedition. Above: The "wild animal man's" home while in the African jungle

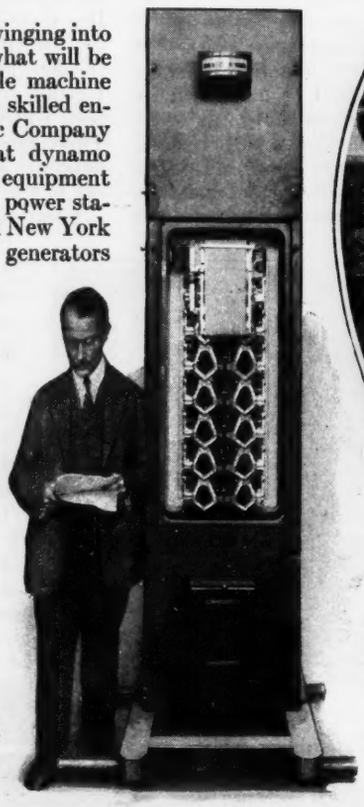


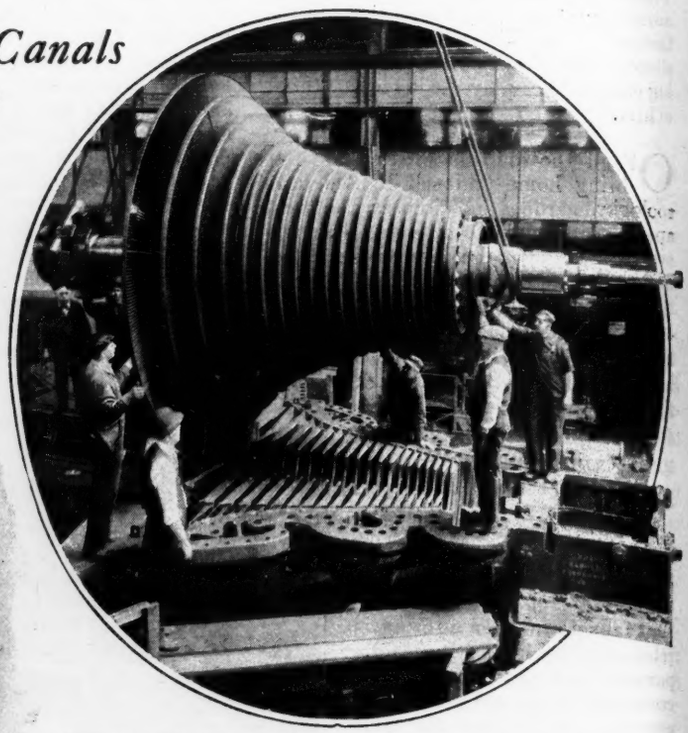
In the short space of fifty years, engineering genius has developed the generator from the small machine below to the giant turbine at the right—the world's most powerful machine. Edison himself worked on the little engine which supplied New York City with power and light in 1882

The Mightiest Machine *on* Earth

Power to Run Thirty Panama Canals Generated from One Unit

GIANT cranes are now swinging into place the last parts of what will be the most powerful single machine in the world. For two years skilled engineers of the General Electric Company have been working on a great dynamo which is to be part of the equipment of the new East river light and power station of the Edison Company in New York City. It is the first of nine generators which will make this station the largest in the world, capable of producing more than a million horsepower.





Above: Lowering the gigantic rotor into place. Planned not so much for today as for the New York City of 1950, with its probable population of 16,000,000 souls, the new light and power station will be the largest in the world. Left: The marvelous instrument which will measure the power

Fifty feet high, this single dynamo weighs more than a million pounds. Such is its tremendous weight and size that it had to be shipped in parts, which are now being assembled by the use of special machinery.

In comparison with this single dynamo, other machines, giants of their kind, are dwarfed. Visitors to Panama may have seen and marveled at three mammoth Diesel engines, 1,000 horsepower each, capable of operating the Canal in case of any failure in the hydroelectric plant. The turbine generator in the New York City station could replace ninety-four of these engines; this single machine, therefore, could operate about thirty Panama Canals.

Again, pulling the Twentieth Century express train out of New York on its run to Chicago requires one of the most powerful electric locomotives in the world, with horsepower of nearly 2,000. The generator which bears the title of the world's most powerful machine is capable of generating 94,000 horsepower. It could pull forty-seven loaded Twentieth Century trains!

If, instead of running trains, its power were used on an ocean liner, it could drive one the size of the *Leviathan*, with power left over to run three trains. In excavation work it would be the equivalent of thousands of workmen. It could operate 2,000 steam shovels.

FINALLY—if you can conceive it—seven cities, of 72,000 population each, could have White Ways and be supplied with electricity for every need by this single powerful unit.

The thousands of blades in its giant rotor are driven by steam. To generate the tremendous quantities needed, six big truck loads of coal, each of five tons, must be burned every hour. Built on the river bank, by the use of ingenious traveling coal-handling towers the station will unload coal directly from ocean-going vessels. Five hundred tons an hour will be unloaded without moving the ship after docking, and ashes will be loaded similarly directly on river scows. This was planned so that the new station would not add to traffic congestion in New York City.

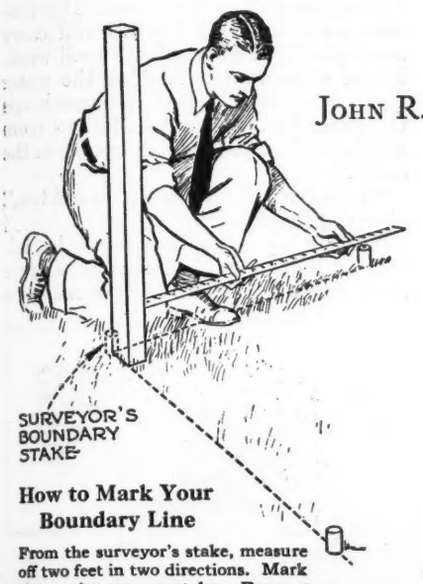
Water to be generated into steam will be borrowed from the East river, passed through huge cast-iron pipes to the station, and a minute later poured back into the river. When the station is completed and in full operation, more water will flow through these pipes each day than is brought down from the Catskill aqueduct to New York City. Eight hundred thousand gallons will be pumped every minute.

The city which is to have the world's greatest steam turbine was also the first in the United States to use a turbine of any type run by steam to generate electricity. This crude machine was brought from Sweden in the nineties, and generated only about 100 horsepower.

Mistakes to Avoid in Placing Your House *on Its* Site

Don't encroach on your neighbors or on the street, or build too near trees—Tips on grading, drainage, foundations and water-tight cellars

By John R. McMahon



How to Mark Your Boundary Line

From the surveyor's stake, measure off two feet in two directions. Mark these points on new stakes. Remove the first stake and locate your post

"WHY in blazes," writes a reader, "didn't you start Rob and Ellen right at the beginning of their home building? I mean, telling them first about locating their house on the lot, grading, making foundations and such-like. A nice young couple like that ought to be told—"

Hold on, friend reader. As a matter of fact I had a preliminary talk with that nice young couple on those very topics, but the report of our confab was postponed for various reasons. I'll give it now. It isn't too late in the season to benefit other home makers.

"Spacing a house on a lot is important, eh?" was the way Rob began it.

"I'll say it is!" was my reply. "People spend oodles of cash to overcome avoidable mistakes in this matter. But before we consider locating the house, we should take a squint at the question of survey."

"That's all done for us, isn't it?" asked Ellen. "I hope you don't expect Rob and me to become surveyors."

"No, but you need to understand some things, and it would do no harm for you to check up your boundaries with a tape-line. It is well to know that a stream given as a boundary is never an exact line; so don't build very near it if you want to avoid dispute with a neighbor. An old fence, especially stone, is a pretty dependable line. The old-time compass surveys are likely to be off, due to local conditions and the shift of the magnetic north pole. The up-to-date surveyor does not use a compass but merely a transit, getting his lines by angles which he bases on fixed points."

"But we get a map or blueprint of our lot, don't we?" inquired Rob.

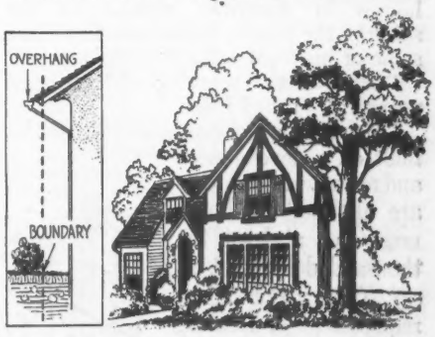
"Yes, if you buy from a realty company; otherwise, probably not. If no map is supplied, you can perhaps fix up one from the official map kept by the county register of deeds. Just make a copy with pencil on tracing paper. In fact, every home owner should look up the public records for himself and verify his documents. You can get your neighbors' lines and holdings as well as your own."

"How about a guaranteed title?" asked the young man.

"So much the better when it's supplied by a responsible title company. The seller does not always give it because of the expense. Without a guarantee, you need a search of title done by a careful lawyer, and generally the buyer stands the cost. Now the map, whether done by a title company or an ordinary surveyor, shows all the boundaries in feet and hundredths—as 98.50, which means 98½ feet on that line. Don't bother with the angle figures also given, which are marked in degrees and minutes, as—" I sketched for them, N. 26° 41′ E. "The map is done according to scale, so that with a foot rule you can figure out on it anything you want."

"It must be rather difficult to match up the lot and the map," suggested Ellen.

"Just look for the surveyor's stakes at the corners," I replied. "Usually these are plain wood with a small nail driven in the top marking the exact point. I'll tell Rob how to replace a stake with a permanent concrete marker or a fence post. Measure off two feet from the nailhead in two directions at angles; mark these points with nailheads on new stakes. Now remove the surveyor's stake and locate the post or marker with a two-foot rule. Get the bottom of a post right, use a level to make it vertical. Of course you allow for post thickness. When the corner posts are up, stretch wires between them to obtain the boundary or to line-up intermediate posts for a fence."



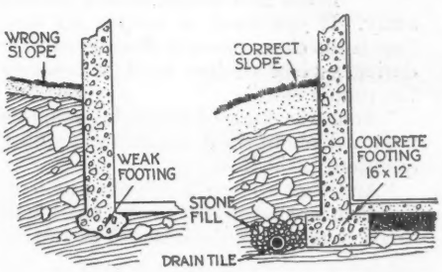
If you build too near the boundary line, your roof may project over your neighbor's land—a serious encroachment. Trees planted too near the house will block off air and light

"Suppose I don't want a fence," said Rob, "or if I do, how about the neighbors joining in on the cost?"

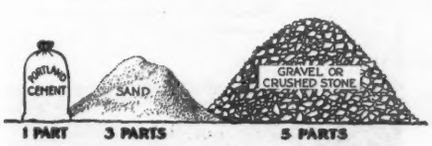
"In many states boundary fences are put up jointly by neighbors under legal regulation. The law may even require your neighbor to contribute his share of fence and its upkeep. By the same token your neighbor may compel you to co-operate on a fence. It is better to keep law in the background and get along by friendly agreement. I would mark a boundary somehow, by a hedge if not a fence. It prevents trespassing and trouble. A fence has legal value; it cannot be removed without mutual consent or certain proceedings. It is good

Are You Planning to Build?

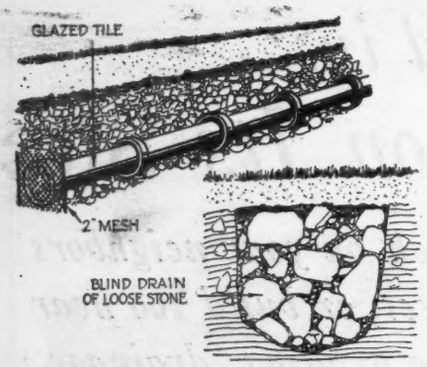
MR. McMAHON'S services are available to assist our readers in solving their building problems. If you are thinking of building a home write to him. He will be glad to answer, free of charge, letters addressed to him care of POPULAR SCIENCE MONTHLY, *250 Fourth Avenue, New York City.*



For a strong foundation, have a concrete footing sixteen inches wide and a foot deep



One part cement, three parts sand and five parts of gravel or crushed stone is best for the foundation. Be miserly with the cement



Draintile lines or blind ditches keep ground near the foundation from getting water soaked. Note the mesh at the pipe opening

insurance for your property. The law usually specifies height and other details required for a boundary fence."

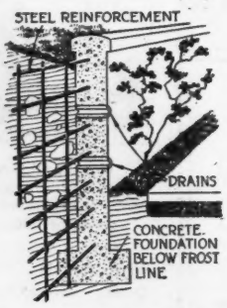
"How about our line on a street or highway?" pursued the young husband.

"The main point is not to crowd the public domain. Don't think your lot extends to the very edge of a narrow public road, which is probably built only half as wide as it should be. Find out the official width, including sidewalk, to avoid encroachment and future trouble. In the last few years several million dollars' worth of front steps that encroached on streets have been shaved off houses in American cities. In the suburbs the greedy owner stands to lose some of his front lawn if not his steps."

"What is the meaning of 'restricted property'?" asked Ellen.

"Usually that cheap houses cannot be built on a development and no factories or stores are allowed. A house must cost at least ten thousand dollars, let us say. There may be also a requirement of locating the building on its lot so that all the houses in a street will stand on a uniform line. We are talking of private development restrictions.

"Some towns and cities have zoning ordinances which restrict the layout of homes. They may tell you how far you can build from the street, side lines and back line. Such regulations are mostly based on fire safety principles."



A retaining wall should have a concrete foundation going below the frost line. Steel rods give it added strength

"BUT couldn't we leave it to our building contractor to find out the rules and place the house right?" inquired Rob.

"Not by several jugfuls. I just heard of a case where the contractor, in the absence of the trustful owner, put up a house smack on the road, because the owner had said he wanted plenty of garden space behind. The architect, if you have one, certainly should have some say on location. If the ground is irregular, he will adapt his plan to suit and pick out the best site. Keep well away from the road for the sake of quiet and cleanliness.

"On the other hand, too far from the road means high cost of putting in water, gas, electricity and sewer connections. Any house within sixty feet of the road can have an electric line direct, without expense for a private pole and its upkeep. You can stand a pole or two to get farther back. But a water line at one to two dollars a running foot, added to other conveniences, soon runs into money."

"Is one lot big enough for our house?" was Ellen's query.

"Hardly, if it is a city lot twenty-five feet wide by one hundred feet deep. The width is the trouble. The house put in the center would have mighty little room left at the sides. If put on one side line, there would be barely room on the other side for the family car to enter its garage. I would advise two lots or at least a width of fifty feet. That is crowded enough for anybody.

"Apart from the question of sunlight, air and privacy, it isn't safe to build on or near a boundary. Your roof may project over your neighbor's property. The line may be wrong by several feet, owing to somebody's mistake. You then have to buy a strip of your neighbor's land at a good round price or move your house."

"You've got me aroused to the encroachment peril for fair," announced Rob. "I'll build plumb in the center of the biggest lot I can buy on the so-little down plan."

"FINE! Now that you've digested one peril, I'll tell you another. Many people misplace their houses without infringing on boundaries. They build too far forward or back, down in a hole or too close to a patch of woods. Be sure that your site is right from every standpoint."

"You say not to build too near a patch of woods," remarked Ellen. "I always like houses that snuggle into trees."

"They look nice," I admitted, "but are not so good to live in. Trees cut off sunlight and air. Their storm-broken branches may damage the house, not to mention telephone and power wires. The falling leaves pile on the roof and clog the eaves troughs, while the roots of the trees creep into drain-tiles, lifting sidewalks and even splitting foundations. Plant shrubs or dwarf trees near the house and keep the big fellows away. If you want to keep a big tree that is too close, prune it down gradually during several winters until it becomes the proper size."

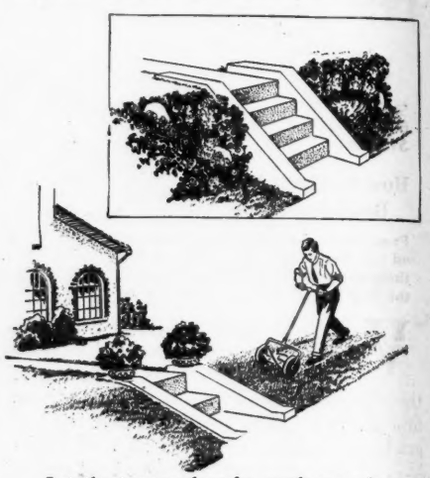
"Your speaking of draintiles reminds me to ask about the drainage and grading question," said Rob.

"And that's often a serious problem. So much so that in some cases the house location might be determined according to natural drainage conditions. It costs money to fight with and divert a lot of water that has a habit of cavorting down a slope or gulch. The dry season means nothing. Find out how the water behaves in spring, fall and winter. It is best, if you can do it, to divert water a good way from the house by grading, that is, making a gradual slope away from the dwelling. Plant grass seed over the slope to make a good lawn. This protects as well as prettifies. It will carry away plenty of water without soil-washing or other harm. Making the water travel far enough from the house keeps the ground near your foundations from getting soaked and making trouble in the cellar."

This is a good method of laying a concrete cellar floor over a bed of six inches of hard cinders

"I guess a few draintiles help out too," observed Rob.

"Yes, they may be needed in addition. Putting a tile line under a grass slope or shallow sodded ditch makes a choice combination. Water is thus carried away both above and under the ground. How deep should the tile be laid? Usually a foot and a half to the top of the tile. You can partly fill above with cinders. I would use a six-inch tile for small jobs, always the glazed bell-jointed kind, which do not crack like the unglazed farm tile.



Let the terrace slope be gentle enough so that you can use a lawn mower on it. On the steep slopes, shrubs will hold the soil

"Instead of tile you can make a so-called blind ditch of loose stones in a trench, covering with a little hay before you fill in with earth. Protect the entrance to your underground drains with two-inch mesh wire."

"HOW about open ditches lined with stone, such as they have along highways?" asked Rob.

"They're costly in labor, likely to clog because of uneven surface, and are hard to keep free of weeds and grass. Frost heaves the stones whether they are cemented or not."

"Suppose our home site needs a terrace and a retaining wall," suggested the young man.

"They are all right if properly built. A terrace is usually an earth embankment with a sod surface. It should be not too steep, with a good layer of top soil so that grass will grow on it. Make a slope that you can run a lawn mower on. If the soil is shifty or the weather unfavorable for (*Continued on page 157*)

The World's Waistline Shrinks

How Globe-Racers Have Cut the Girdle of Transportation

WHEN Linton Wells of New York City and Edward S. Evans of Detroit reached New York at the finish of their recent sensational dash against time around the world, the official timekeeper clicked his stop watch and registered exactly twenty-eight days, fourteen hours, thirty-six minutes and five seconds, nearly eight days less than the record set thirteen years before by John Henry Mears.

In their remarkable achievement, twelve airplanes, three special trains, one automobile, magnificently powerful ocean liners, and many small boats and land vehicles were called into service.

The latest record-smashing dash affords a remarkable contrast with the historic globe-girdling achievement of Nellie Bly in 1889–1890. She undertook the trip as a challenge to those who scoffed at the fictional hero of Jules Verne's novel "Around the World in Eighty Days." Nobody in those days believed it could be done outside the covers of an imaginative book. But she did it, and bettered *Phineas Fogg's* mark by eight days.

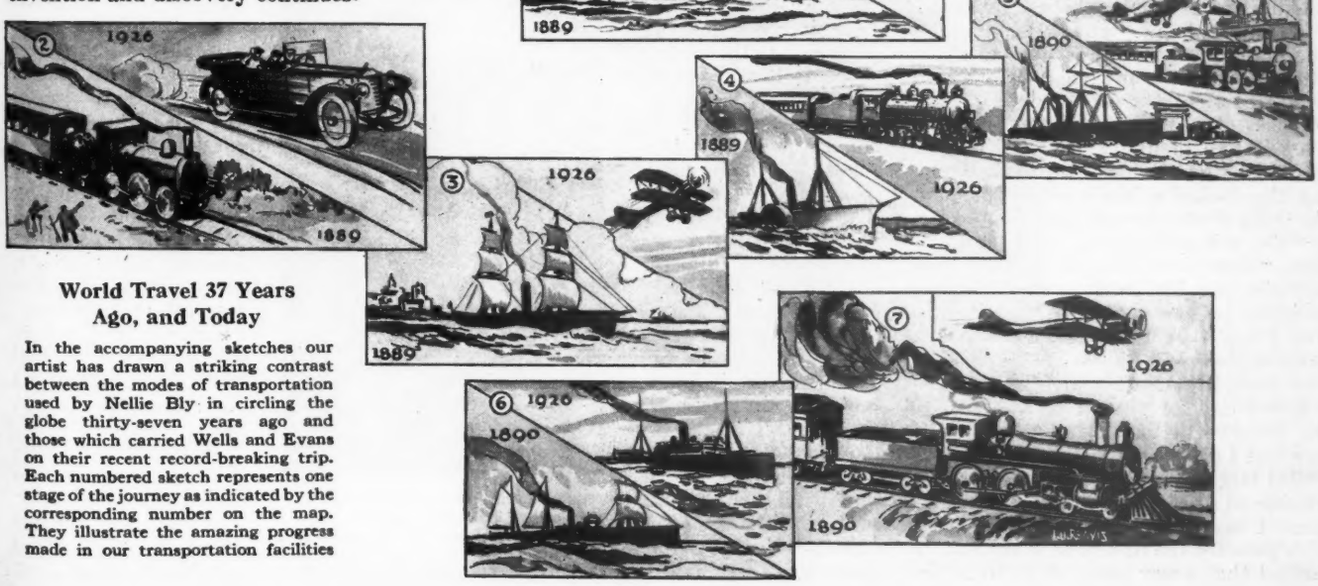
Since her attempt, the record has been clipped several times. In 1903, Henry Frederick completed the circle in fifty-four days. Eight years later, Andre Jaeger-Schmidt cut the time to thirty-nine days. Then John Henry Mears, in 1913, set the mark of thirty-five days, twenty-one hours, which stood until Wells and Evans cut off seven days and seven hours.

Their record may not stand long, for John Henry Mears, the previous record holder, is preparing to better their time by rearrangement of plans and time-tables.

What the world is looking forward to, however, is the first circumnavigation of the globe by nonstop airplane flight. And the time for that is not very far off, if the present pace of science, invention and discovery continues.

Twentieth Century Magellans

In the first circumnavigation of the globe, four centuries ago, Magellan started with five ships and 270 men. He was killed in the Philippines, and the expedition returned with only one ship and eighteen men. The trip took three years, and all that time the explorers were lost. In the latest round trip Wells and Evans were in hourly communication with the rest of the world, and returned in less than a month, none the worse for their adventure. The picture above shows Wells (left) and Evans (right) after completing the last lap by airplane, at Mitchel Field, N. Y. They were greeted by John Henry Mears (center), previous record holder

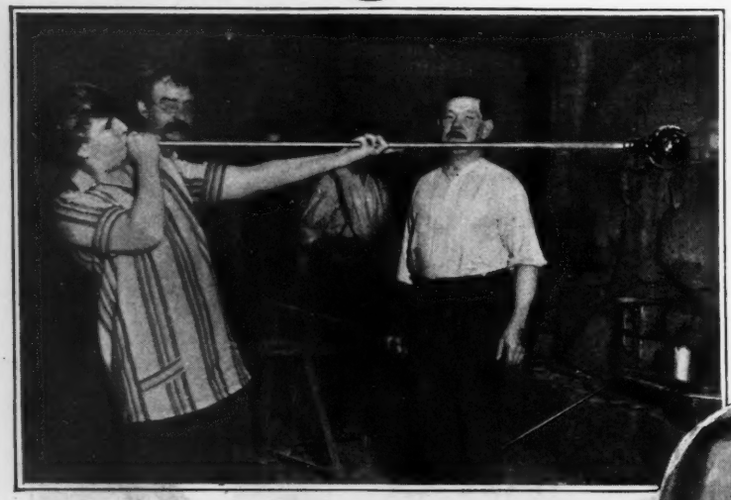


World Travel 37 Years Ago, and Today

In the accompanying sketches our artist has drawn a striking contrast between the modes of transportation used by Nellie Bly in circling the globe thirty-seven years ago and those which carried Wells and Evans on their recent record-breaking trip. Each numbered sketch represents one stage of the journey as indicated by the corresponding number on the map. They illustrate the amazing progress made in our transportation facilities

Magic Things We Can

We Bounce and Bend It, Saw It Like Wood; Even Stop Bullets with It!



Fine Glass Is Still Blown by Mouth

A noted women glassmaker exhibits her skill at blowing a glass jug. Mrs. Graydon-Stannus makes old Irish handmade glass at her plant in Peckham, Eng., from family recipes 150 years old

Optical glass made by the Bureau of Standards, which supplies most of such glass used by the Navy Department. Each one of these melts weighs 1,000 pounds

MOST of us, if we stop to think about glass at all, think of it as a mysterious but important something which is extremely fragile. Many of us, if asked to define what glass really is, would be at a loss to go beyond the statement that it is the most smashable of all the common things we use every day.

As babies, we gaped, fascinated, to see a drinking glass, dropped from our hands, crash in splinters. In boyhood, the crackling of a window pane, hit by baseball or brickbat, gave us a tingling thrill. So, out of experience, we have come to look upon the stenciled statement, "Glass—Handle with Care," as representing about all we could say of this mysterious material.

I confess, for one, that my thought about glass was limited to some such idea as this until the other day, when I chanced to be talking with a New York architect. We were standing at a window looking out at the Woolworth building.

"Did you know," he said, pointing to the majestic tower rising 800 feet above Broadway, "that fully one third of all the wall area of that great building is made of glass—ten thousand lights of plate glass in five thousand windows?"

I ran my eye up to the top of the building, then looked at him in astonishment as the truth of what he said dawned upon me.

"Yes, it is astonishing," said the architect, "when you think of all that glass withstanding, like brick or steel, the tremendous pressures of gales and storms. Yet I am told that, of all those ten thousand window lights, not more than two dozen break in a year."

Every day for years I had passed by the Woolworth building, but not until now had I ever conceived of it as a tower walled largely by the stuff I always had considered so perishable. From that moment I began to get really acquainted with glass for the first time in my life. I learned that every piece of it, from the cheap tumbler to the wonderful stained glass window of a cathedral, is full of surprise and the magic of craftsmanship.

From the common sand of the earth, mixed with chemicals and melted by fire, men for centuries have fused glass for our use. Through its crystal transparency we view the world about us during most of our workaday hours. At night, through it, our homes are flooded with light. In our automobiles it lets us see the road ahead. To it we owe our cameras and our motion pictures. In the microscope it has given us eyes to see the wonders of the world of small things. In the telescope it has brought us knowledge of realms billions of miles away. There are many of us who would go through life almost blind but for little round lenses of glass to see through.

GLASS may be fragile, but it does stand use. To list even the common necessities it supplies to us would be an almost endless task.

Such is the magic of glass. Its romance stretches back somewhere beyond the dawn of history, when the secrets of glass-making were first learned. Who discovered them, or where, remains a mystery to this day. We know that almost 5,000 years ago inhabitants of the valley of the Euphrates were making glass baubles. And 3500 years ago the Egyptians were using it.

Glass, according to the dictionary, is made of sand and is brittle. But this new "flexible glass" is not made of sand and it bends and bounces! When cold, it pours like a liquid

In the Harvard University Museum there is a beautiful collection of 3600 glass models of flowering plants, so perfect that even botanists have thought they were looking at real plants. It is the classic example of the modern glass blower's art. The beauty of these glass flowers, wrought by Leopold and Rudolph Blaschka, famous Dresden glass artists, defies description. Every leaf, every delicate petal, every blend of coloring of the real plant, is reproduced with amazing artistry.

FOR centuries Venetian glass has been famed the world over. The making of fine glassware sometimes is called a lost art, but

Do *with* GLASS

By EDGAR C. WHEELER

it is an art that never has been lost in Venice, where, in the famous Barovier glass factory in the suburb of Murano, as beautiful glassware is made today as was made in the Middle Ages by the ancestors of the present heads of the establishment. One of the artistic specialties of this old firm is the making of liquor flasks in the forms of fanciful animals. Fine "mosaic" glass, into which tiny pieces of colored glass are blown by a secret process, forming designs and color combinations of extreme beauty, is another famous product.

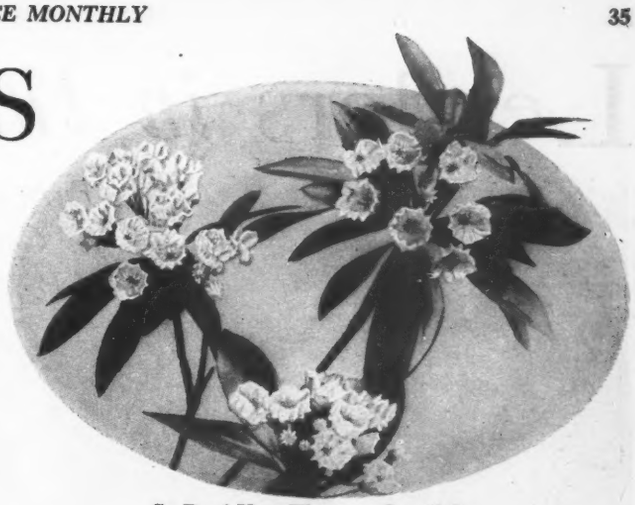
I HAD thought, at the beginning of my investigation, that after some five thousand years glassmakers would have mastered about all there was to be known of the art. The fact is, though, I learned, that some of the most important creations in glass are products of our own times. Only recently, for instance, have we approached fulfillment of the dream of making a glass that will not break.

Necessity, in the guise of a pest of holdup men, gave us the tough, bullet-resisting glass sometimes called "transparent steel." It is clear and colorless as fine plate glass, yet the bank teller who counts his notes behind an inch-thick window of it in your bank is perfectly safe from the gunman who shoots at him with a .45 caliber pistol from a distance of ten feet. Two inches of transparent steel will discourage a .30 caliber steel-jacketed rifle bullet. The glass will crack in fine fan-shaped lines under the impact, but will stop the bullet, not even splintering.

This "transparent steel" is not all glass, I learned. In its manufacture, sheets of elastic substance, like celluloid, are placed between layers of plate glass, and the whole welded together under pressure at high temperature. I have seen it on armored express cars, with marks of bullets on it, too, but no bullet holes! And I have seen it in some of the latest automobile models. Its makers, so they tell me, expect that it will be widely used for motor car windows and windshields, and railroad coach windows.

EQUALLY remarkable is the new "flexible glass" or "synthetic glass" invented by two Austrian scientists, who claim that it has all the useful properties of real glass, yet is virtually unbreakable and can be bent to any shape desired.

"Flexible glass" is a condensation product of formaldehyde and urea. In its liquid form it can be poured and molded as easily as glue. Upon being subjected to a certain degree of heat, it becomes hard and glasslike. It is clear and colorless, but can be dyed easily. It bounces like a rubber ball, and when at last it breaks, it breaks without splintering. The inventors say that, though it weighs only half as much as real glass, it can be produced at the same cost.



So Real You Want to Smell It

This sprig of mountain laurel is part of the famous glass flower collection at Harvard University—flowers so perfect that microscopes reveal even the fine granules on the filaments of stamens!

STILL another comparatively recent creation is heat-resisting glass. I know my wife has cooking utensils made of this strange material. Although intended originally for apparatus in chemical laboratories, it is found now in almost every home. In this discovery, experimenters were astonished to find that the addition of boric acid and white aluminum rust to the ordinary materials for window glass produced a glass tough enough to stand the most extreme changes of temperature without breaking.

You can fill a tumbler or bowl of this glass with ice water, place it over an open flame and bring it quickly to the boiling point, and the glass will not crack!

Perhaps the most astonishing product of all is glass wool. At first glance you would see little in common between your window glass and a mass of light, fluffy stuff that looks and feels like silk. Yet the panes in your window and glass wool are made of the same material.

The wool is glass spun into threads so fine that it would take 2800 of them, laid side by side, to make a ribbon an inch wide.

Once upon a time this fluff, so light and delicate that it will float in the air, was used in making curls for French courtiers. Today its most important uses are for insulation for filters in the manufacture of chemicals, and for ink erasers.

I HAVE watched the method of producing it. A glass rod is heated in a flame. When a small piece of cold glass is touched to the heated rod, a thread of molten glass sticks to the cold glass. Instantly the thread is fastened to a wheel about the size of a bicycle wheel. As this wheel is revolved, the "wool" is spun from the glass rod.

Ninety percent of the space occupied by glass wool is air space. That is what makes the material so efficient as an insulator. If you could look between the walls of the refrigerator in your home, you would quite likely find spun glass packed there.

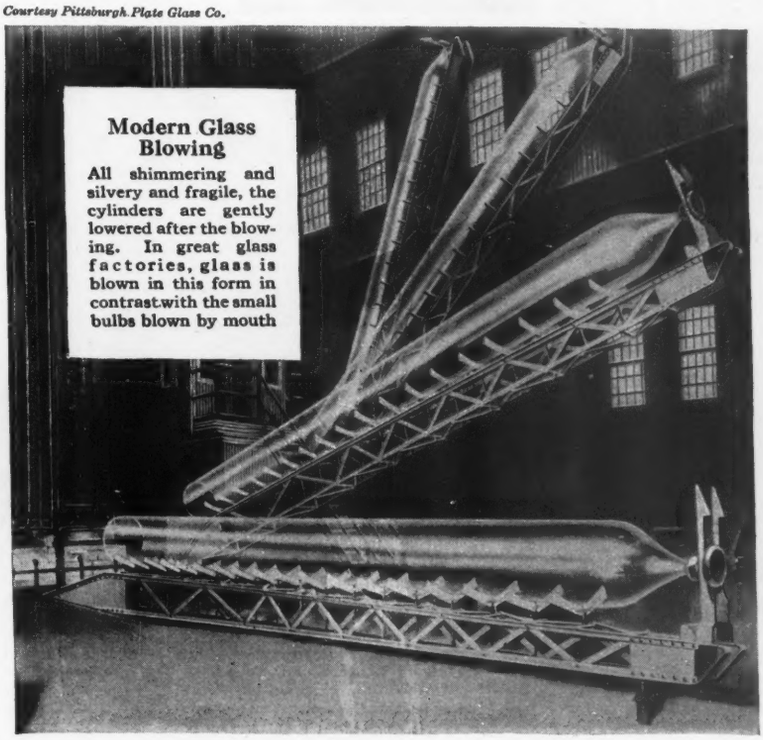
Marvelous as such a product is, it is hardly more so than are the prosaic flat panes of glass through which you look every day.

Did you ever wonder, for instance, why it is that through some windowpanes objects appear wavy and distorted, while through other panes the images are perfect? The answer is this:

The panes which cause distortion are made of glass bubbles blown into cylindrical form and then flattened out. In the process the glass film does not always remain exactly uniform at all points, and distortion results. The clear panes, on the other hand, are plate glass, made by pouring molten glass into

(*Continued on page 159*)

Courtesy Pittsburgh Plate Glass Co.



Modern Glass Blowing

All shimmering and silvery and fragile, the cylinders are gently lowered after the blowing. In great glass factories, glass is blown in this form in contrast with the small bulbs blown by mouth

Leaders *in the* May Contest

Turn to Page 161 for Complete List of Prize Winners

FIRST PRIZE

"My wife and I are always digging and planting in the garden; that's how we caught John and Mary messing things up in theirs." So writes W. A. Carrie of Jacksonville, Fla., winner of the first prize of $500 in the May Contest. He is foreman in the engraving department of a Jacksonville newspaper

SECOND PRIZE

Dwight L. Booher, a railroad telegraph operator of Plymouth, Ind., first noticed the "What's Wrong" Contest while looking through our March number in the Public Library. He entered the March and April Contest and now wins the second prize of $100

THIRD PRIZE

Arthur P. Bach (left), an accountant of St. Paul, Minn., wins the $50 prize. The picture shows him with two of his three daughters, who helped him

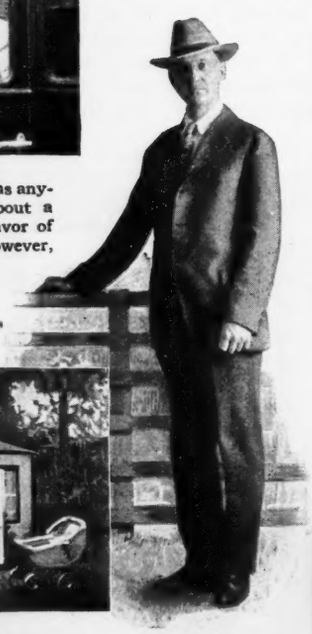
Each One of Them Receives a Cash Prize

Harold H. Clarke, Victoria, B.C., is a first class constable in the British Columbia Police. "I spent many enjoyable hours solving John's and Mary's mistakes," he writes

Every evening for two weeks David T. Rayner (below), of San Jose, Calif., studied the Contest picture. He is a horticultural inspector, twenty-nine years of age

"I didn't think there was anyone as stupid as I about a home, but I pass in favor of Mary and John." However, Marad Serriov, of Miami, Fla., says she has learned a lot studying them

As a school executive, John P. Howe (below) of Gardena, Calif., has found POPULAR SCIENCE MONTHLY "a storehouse of valuable aids in repairs and construction work"



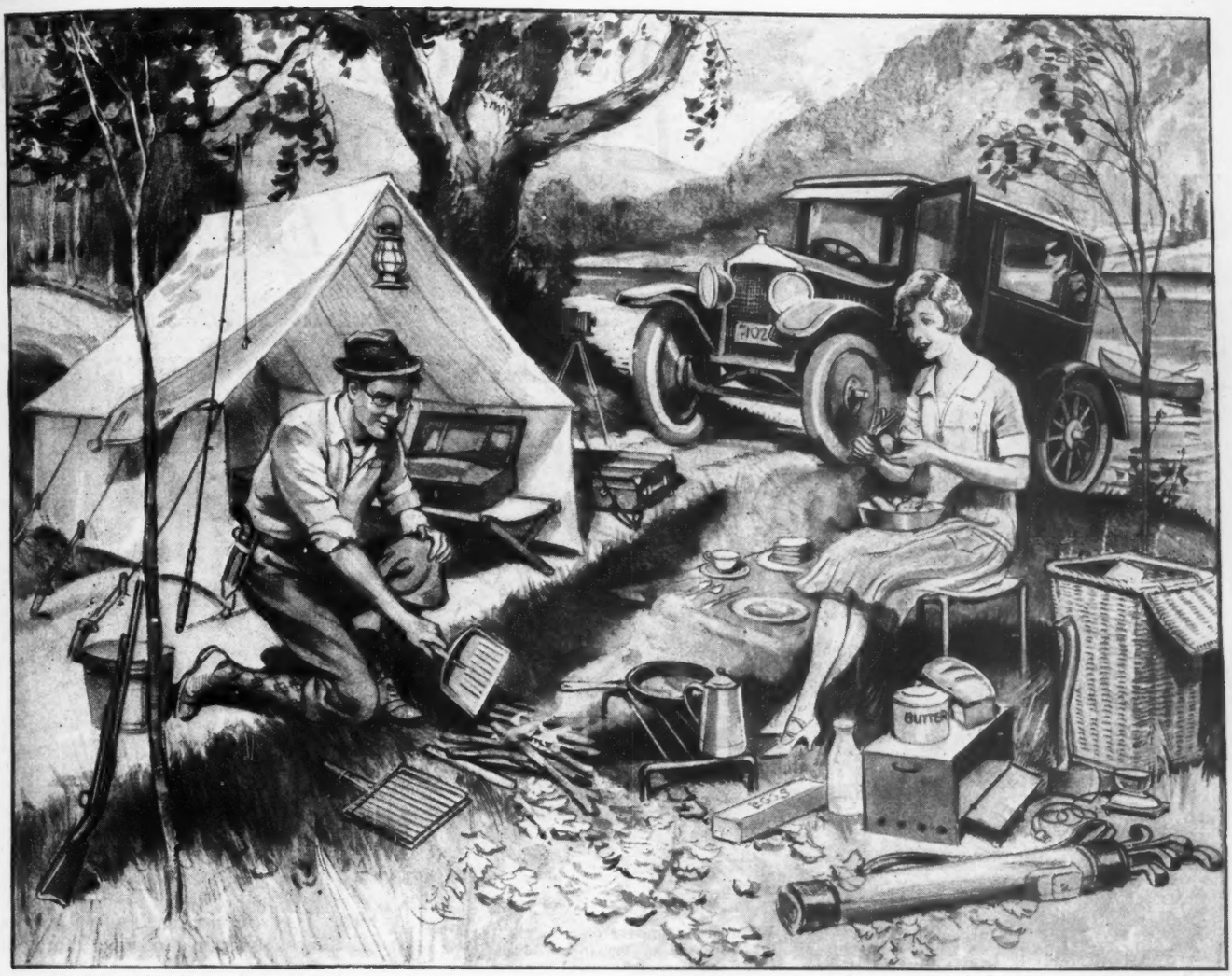
Frederick J. Bryant is supervisor of manual training at Auburn, Me. He became interested in the May Contest after some of his pupils had tackled it

Contests are a hobby with Charles U. Read, a newspaper editor of Upper Sandusky, O. "I have found nothing better to keep cobwebs out of the brain," he asserts

Instead of a picture of himself, James P. McCauley, of Salem, Va., sent us this snapshot of the playhouse he made for his little girls. His favorite pastime is making doll furniture for his youngsters

Arlo D. Gerst, a department store clerk of Lebanon, Pa., found "a lot of food for the brain" in working on the Contest. The picture at left shows him with his family

"Hope to be on your list again next month, as I think I am getting better," writes Dr. Percival W. Darrah, a surgeon, of Leavenworth, Kan. He finds much pleasure and relaxation in puzzles



JOHN and Mary are enjoying their first camping trip, and in planning their equipment and setting up their camp, they of course made many laughable mistakes. What are they doing, or have done, that is wrong? What additional errors has the artist made? See if you can find more mistakes than your friends or the other members of your family can, in this, the last of the John and Mary pictures to appear in these pages

What's Wrong *with this* Picture?

JOHN and Mary Newlywed are bidding goodbye to their thousands of friends among readers of POPULAR SCIENCE MONTHLY in this month's issue, and the farewells on both sides will not be uttered without a tone of sincere regret. It is not at all unnatural for readers to feel this way about it, for during the many months they have been with us, this young couple have proven a high source of entertainment, amusement and education by their erratic attempts at homemaking and housekeeping.

They tried hard, though, and while they made many laughable mistakes, turned many things upside down, and did many things hindmost forward, they were learning all the while. In watching eagerly for their blunders, making note of them, and remembering them, interested readers also have gained immeasurably. For the way to Truth, the sages say, lies through error.

John and Mary have their own reasons for leaving us. Experience has taught them much, and now they want to be alone, to work things out their own way, and in the way they have been taught by the thousands of criticisms sent to them from sympathizing readers.

Moreover, it has become increasingly hard to detect them, in their daily routine of living, in the commission of error. Even the artist has benefited by practice, and so deprives us of the pleasure of finding his mistakes, too.

So our last glimpse of John and Mary is on their farewell trip. Of course, camping out is new to them, so in this picture they are making several more comical errors. The artist has slipped up here and there also, in his agitation at saying goodbye to his characters.

In next month's issue the winners of the June contest will be announced. Watch for it.

The Most Fascinating Game You Ever Played

A NEWLY discovered pastime, as alluring as cross-word puzzles, as enjoyable as a card game and as scientific as chess, will be introduced in the November number of POPULAR SCIENCE MONTHLY.

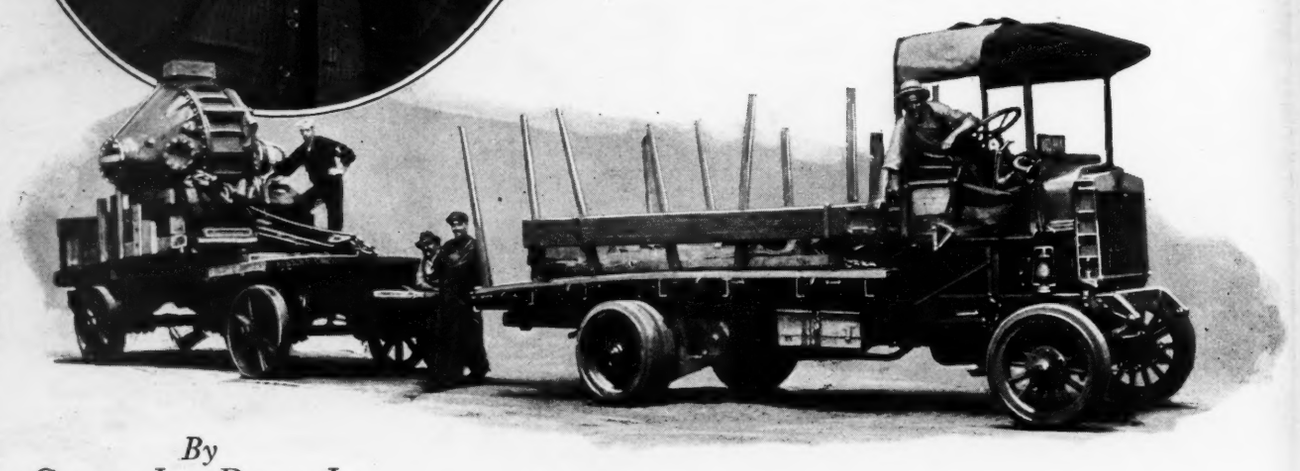
There are no intricate rules; you understand the game the instant you see it. You can play it alone, or you can make of it a fascinating competition. In short, it is everything a game should be.

You will find playing this game thrilling for its own sake. But to supply additional incentive for exercising your ingenuity and skill, POPULAR SCIENCE MONTHLY will offer prizes to be distributed among those who realize best the game's possibilities.

Full details will be printed in our next issue.

This Modern Atlas Lifts Tons with His *HEAD*

How a Rigger Hoists Tanks to Dizzy Heights, Swings Smokestacks in Place, and Hauls Steel Girders



By
GEORGE LEE DOWD, JR.

One of His Lighter Jobs

When an Italian naval officer went shopping in New York and bought an 18-ton gyroscope, the job of getting this trifling purchase to the ship was entrusted to Dick Doughty and his riggers. This is how they did it. Above at left: Richard R. Doughty himself

ATLAS of ancient mythology lifted the world on his shoulders.

Richard R. Doughty, Atlas of modern times, lifts colossal loads with his head.

"Dick" Doughty is a veteran boss rigger. No doubt he might claim the title of champion hefter and hauler of America. For during half a century of thrilling adventure and hair-raising achievements, he has used his head and risked his neck hundreds of times to beat the law of gravity. Juggling hundred-ton dynamos and hundred-foot smokestacks has been child's play for him. He has hoisted mountainous loads up the sides of skyscrapers, and has dragged thousands of tons of steel girders for great bridges and buildings. In almost every part of the country he has performed feats that might have broken the backbones of the giants of old.

To him each new lifting job is not merely a spectacular test of brawn; it is a fascinating challenge to wits and skill. This much I learned the other day when I found Doughty before a downtown New York skyscraper, superintending the job of raising a twenty-ton steel water tank to a roof above the twenty-second story.

A section of the street had been blocked off by lurid "Danger" signs, and in the center of this cleared space stood the gray-haired, weather-hardened figure of the boss rigger, barking orders to his men. Curious pedestrians, lining the opposite sidewalk, craned their necks to watch the huge cylinder sway in the clutch of Manila ropes as it was dragged upward inch by inch. Three or four pygmy figures scurried perilously on narrow beams high above the deep canyon, or swung like monkeys on the ropes of the hoisting tackle. What if a stay should slip or a knot loosen, and the whole twenty-ton burden come hurtling down?

Doughty jerked a pipe from one corner of his tight-lipped mouth to the other.

"Yes, sir," he said, without shifting his gaze from the job overhead, "you can move any load anywhere—if you use your head to do it. If you can budge a thing at all, you can move it any distance. That's the idea. Sure, it's easy to move a safe, or a piece of machinery or a tank to the top of a building. It's as easy as playing pinochle—if you know how."

JUST then one of the pygmies up near the sky slid nimbly down a rope, braced his feet against the wall of the building, pushed himself violently outward, then swung back again in a swift, easy arc into a window. The spectators gasped. Dick Doughty smiled approvingly.

"Now that's what I call headwork," he said. "Every one of my riggers up there has a level head on his shoulders. They have to have, or they wouldn't be riggers. That was a sailor's stunt," he went on. "Lots of these riggers come from ships. They can do anything with ropes and knots, so rigging comes natural to them.

"Of course there's some danger to it, sometimes. I'll never forget the time I took a tumble"—

And Doughty related the story of his narrowest escape from death. It happened when he and a crew of riggers were working inside a building under construction on Pearl street, New York, hoisting a five-ton lithograph press up a shaft to the fifth floor.

ROPES strained, tackle creaked, and the press slowly rose as the pulley block gripping the rope sling around the press climbed to meet another pulley block fastened above the fifth floor. A final tug, and the two blocks met. And then Doughty discovered they had made a misjudgment of six inches. Two timbers fastened beneath the press to serve as skids prevented swinging the machine onto the floor.

"Take off the skids," Doughty ordered.

The riggers began to unscrew the bolts—three bolts to a skid. Doughty himself climbed out on one of the swaying skids and loosened an end bolt. Meanwhile, unknown to him, one man had removed the middle bolt. Doughty might just as well have been sawing himself off the end of a limb. Without warning, the skid fell. Doughty dropped like a plummet down the shaft. To the horrified riggers it looked like sure death.

But as he plunged downward, Doughty clutched at a rope that dangled from the press for three stories down the shaft. The rope burned through his fingers, yet

he tightened his grip. His hands, torn to the bone by the friction, clutched tighter and tighter, until two feet from the end of the rope he stopped his plunge—two stories in midair!

Still he hung on, while the shaken riggers pulled him to safety. When his hands had been dressed he went back to work. The job was finished that night.

If this adventure illustrates the hazards of the rigger's calling, it also gives some idea of the courage and resourcefulness by which Dick Doughty has come to excel in the science of lifting and moving heavy loads. By headwork he has lifted himself from his starting point as a truckman to that of directing owner of an important industrial concern.

In the list of jobs he has done successfully were the hauling of 10,000 tons of steel cable for one of the Brooklyn bridges—his first big contract; the moving of thirty vault doors of the Federal Reserve Bank of New York, weighing from fifteen to eighty-five tons; the hoisting of elevator and ventilator machinery thirty-five stories to the top of the Singer Building; the suspension of the 220-ton propeller shaft of the liner *Leviathan*.

EVERY one of these gigantic tasks was full of adventure, danger, romance and heroism. That they were accomplished at all, Doughty told me, was due largely to the fine skill and courage of the riggers who worked with him.

"Take that Federal Reserve Bank job, where we hauled the largest bank vault in the world," he said. "That was one long grind—nothing but hard work and obstacles at every step. First, we had to get permits; permits to cross bridges with our heavy tractors; police permits to block streets for hours at a time while we rolled and lifted the pieces into place; permits to put our heavy trucks on the ends of ferryboats and have the ferries turn around in midstream so that our end could be docked first.

"THEN we had to figure out safe ways of shipping the huge parts of the vault across country, over a river, and through the streets of the city.

"The last lap across the city was the toughest of all. We had to pick a route to the bank over cobblestone streets, for a heavily loaded truck sometimes will sink into asphalt pavement. Each door was lifted by a derrick from the lighter and placed on a special trailer, which was pulled by two trucks as far as the streets were level. Whenever we came to an upgrade, seven more trucks joined in the pull. Arriving at the bank, the door was jacked up off the trailer and under it we placed huge timbers. By means of rollers fed under the timbers, the big slab of steel was moved slowly into the building over a floor especially reinforced by heavy beams.

"The special trailer we used to carry it we call the 'Infant'. It can carry one hundred and twenty-five tons. Some baby, that! The rear axle, of manganate steel, is ten inches in diameter. Each wheel is cast in a single piece of steel, and the rear ones weigh three thousand pounds apiece.

"Every foot of the streets over which the 'Infant' hauled those huge vault doors was laid with steel plates. We picked up the plates from behind the trailer and put them down again in front."

The most ticklish job Doughty ever tackled, he told me, was lifting a sixty-five-ton dynamo by a crane that was supposed to lift not more than fifty tons. The problem called for all his ingenuity, for the dynamo had to be hoisted forty-five feet in the air, then carried 125 feet over a vast power house floor filled with electric engines.

DOUGHTY determined that, if tenderly handled, the crane could be made to carry the extra load. The way he went about it was this: When the end of the crane cable had been made fast, the dynamo was raised for a distance of only thirteen inches off the ground. Immediately riggers slipped four timbers underneath the suspended machine. Then the crane let the load down one inch to the timbers, which held it firmly one foot off the floor. Again the load was lifted thirteen inches, four more timbers were slipped beneath, and again it was lowered one inch to rest.

This process was repeated, until the tower of crossed timbers had risen to a height of forty-five feet. The next step was to swing the load overhead across the room and above the tops of whirring machinery. This done, the crane halted the load directly over a spot where had been prepared a second forty-five-foot crib of twelve-inch timbers. The riggers slowly let the load descend, removing the timbers layer by layer, until at last the dynamo rested on the spot where it was to be installed.

Thus, in lifting and lowering, the fifty-ton crane never was required to suspend the load more than thirteen inches above a resting place.

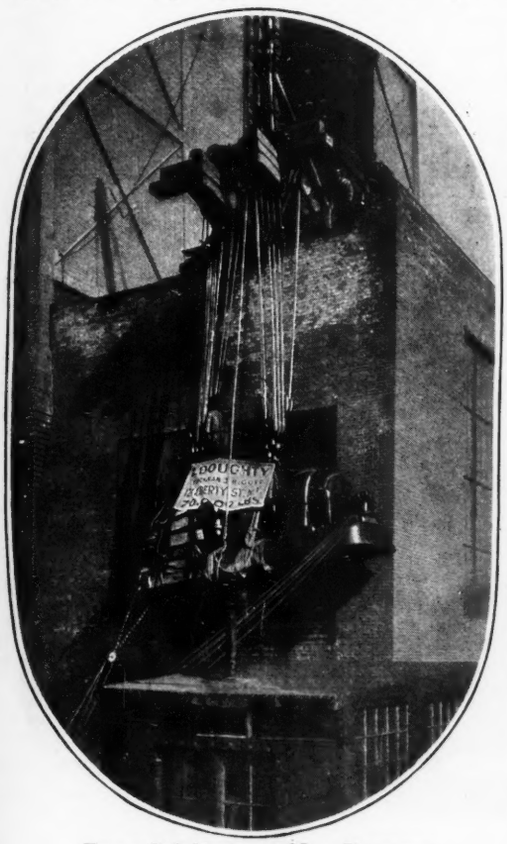
"What was the biggest job you ever tackled?" I asked.

"That would be hard to say," Doughty replied. "But the one job that was most important to my mind was one we did during the war. A crew of a hundred of my riggers worked night and day for seven months to suspend the two hundred and twenty-ton propeller shaft of the *Leviathan* above its housings and bearings. The purpose was to let American engineers regrind the shaft which enemy officers had put out of business by dropping emery into the shaft bearings."

"WERE you ever stumped—ever start anything you couldn't finish?" I inquired.

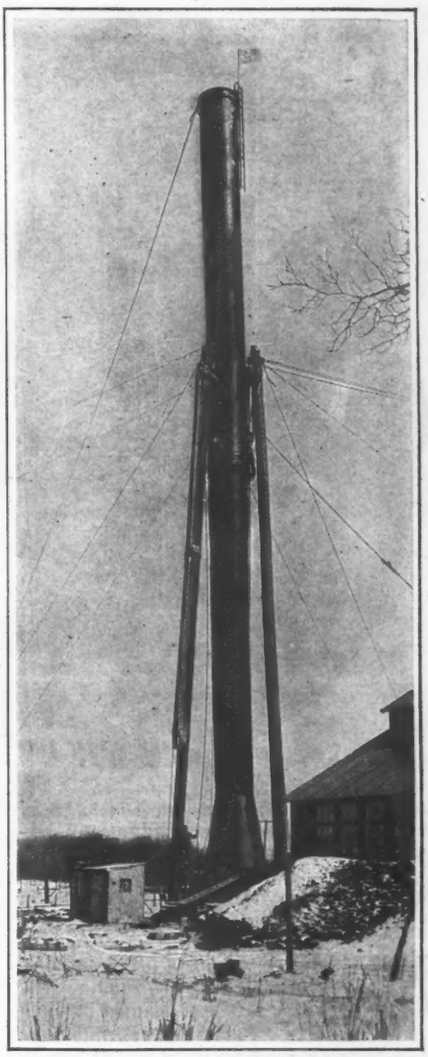
Doughty knocked wood.

"Never," he replied. "But there was a twenty-two-ton, one-piece steel smokestack at Stamford, Connecticut, whose erection gave me (*Continued on page 162*)



Every Job Presents New Dangers

When Doughty's riggers hoist a safe or a dynamo to the upper story of a New York skyscraper, or water tank to the roof, crowds gather—and gasp—to watch them



How Would You Do It?

The problem of erecting this 22-ton, one-piece, steel smokestack, Doughty confesses, gave him a nightmare or two. He finally solved it by borrowing an idea from the circus

Science Continues

Invisible Finger Prints Detected

Helium At Last Is Solidified

More than half a century ago the element helium was discovered. In 1908 a Dutch scientist liquefied it. But it was not until this year that another scientist — also Dutch—at last succeeded in solidifying it. He is Professor W. H. Keesom, shown here with a test tube containing the first transparent, solidified helium. Exposure to high pressure and excessively low temperature produced the transformation

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

Says Our Towns Could Reclaim Iron Junk by Electrolysis

MILLIONS of tons of iron now rusting in trash heaps throughout the country can be reclaimed by electricity, asserts Charles P. Perin, New York mining engineer, in a recent report of his to the Engineering Foundation.

"Discarded iron objects, from cans to automobile bodies, are increasingly disfiguring the countryside, especially near communities," he says.

"Large tanks of iron solvent, ferrous chloride for example, could be maintained in convenient places, into which these wastes could be dumped. Then the iron could be recovered by electrolysis." In other words, if our villages and towns saw that iron junk was dumped into such tanks, they would find a considerable addition to their treasuries every year.

Considering that twenty million tons of iron and steel are destroyed by rust every year in the United States, the suggestion appears to be one of no mean value, especially since Mr. Perin points out also that electricity can be made to produce iron that will rust less rapidly.

Men Have Better Judgment, Women Work Faster

AT LAST you'll have to admit that your wife can work faster than you can. Likewise, she must agree that your judgment is better than hers—in the long run.

Such conclusions, at least, are substantiated by a series of tests given to 542 women and 542 men, all college students, under the direction of the Psychological Laboratory of Johns Hopkins University.

It was found that in the task of substituting letters for symbols the women, on the average, could do more in a given time than the men. The latter, however, were more accurate in judging in advance the amount of work they could do in the time allotted.

For License Tags Easy to Read

FITTING our millions of motor cars with license plates that can be read easily presents a problem. Science recently offered a possible solution.

James D. Weinland of Lehigh University employed fifteen college students to determine what combinations of letters and numerals they could read most readily. Exposing different license plates to view, each for one fifth of a second, he found that while the readings were 90 percent correct when only five numerals were used, the accuracy of reading dropped to 56 percent when the numerals were increased to six. Three letters and three numerals in combination resulted in a score of 76 percent when the numerals preceded the letters, and 70 percent when they followed the letters. For four letters followed by two numerals, the result was 85 percent correct readings, but with three letters and four numerals, the score dropped to 45 percent.

With these findings as a basis, Mr. Weinland says it is possible to obtain as many as 20,000,000 license number combinations, all of them fairly readable.

Water Gas May Give Us Our Future Gasoline

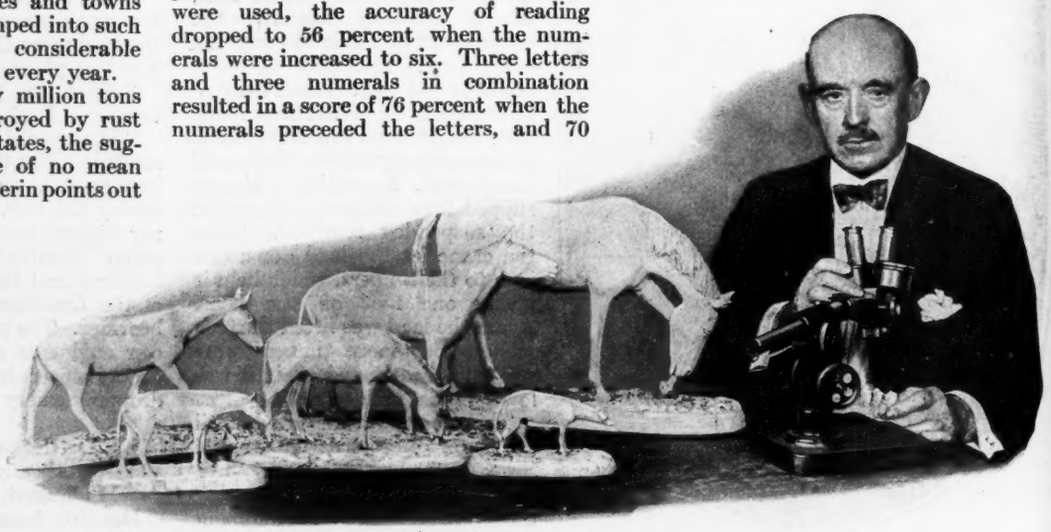
FROM the chemical laboratory comes the promise of an important new source of gasoline in the future. This source is water gas, which forms a part of most city illuminating gas, and is obtained by passing steam over hot coke.

As the result of experiments in the Kaiser Wilhelm Research Institute for Coal Products in Germany, Professor Franz Fischer reports that by using a catalyst, or substance which accelerates chemical reaction, not only gasoline, but wood alcohol, vaseline, and other related products can be obtained from water gas.

New Switch Cuts Huge Current Flow Like Scissors

PROGRESS of electrical engineering has been marked by two important developments in recent weeks. One of these is the invention of a vacuum electric switch by R. W. Sorensen, of the California Institute of Technology. The other is an announcement that the research committee of the American Institute of Electrical Engineers has undertaken a world-wide study of means to prevent by insulation the leakage of electric current.

The perfection of the vacuum switch promises great economies in industry, where the problem of interrupting the flow of thousands of horsepower of elec-



Where Was the Home of the Horse's Fourteen-Inch Ancestor?

Horses were no bigger than cats countless ages ago, and had five toes. But where was their favorite stamping ground? Science is trying to find out. Dr. James W. Gidley, paleontologist of the Smithsonian Institution in Washington, is engaged in looking up this interesting fourteen-inch ancestor of man's most faithful and helpful friend

Its Conquests

and Helium Is Solidified

tric current has involved the use of enormous oil-immersion switches, sometimes occupying acres of ground. In contrast, Professor Sorensen's switch operates in a small glass vacuum tube. It works on the principle that electric current will not travel through a vacuum. In recent tests the switch instantly stopped a current of more than 50,000 horsepower.

In the study of electrical leakage, the American Institute hopes not only to prevent economic waste but also to reduce the danger of short circuits.

Speed-Mad Engineers Put Up Bridge in Ten Minutes

ALMOST every day we hear of some new speed record established by man's skill and ingenuity. A few weeks ago, for example, engineers of the Pennsylvania Railroad removed an old bridge at Tiffin, Ohio, and replaced it with a 200-ton steel bridge—in ten minutes!

The new bridge had been assembled near the site. Immediately after an express train had passed over, the old bridge was quickly ripped out and the new steel structure was slipped into place. Two minutes later another train passed over, operating on regular schedule.

It's the Biggest Thing We Know

ASTRONOMERS at Harvard College Observatory are studying what they say is the largest thing known to science—a superuniverse so far out in space it takes ten million years for light from its center to reach us, yet so vast that a light ray would require two million years to cross it.

The largest thing is described as a cloud of galaxies containing at least 103 spiral nebulae or separate universes like the one of which our sun and stars are parts. It was in one of these nebulae, known as Messier 61, that the German astronomer Max Wolf discovered the far distant new star described in last month's issue of POPULAR SCIENCE MONTHLY.

Where Is Our Food Coming From?

PROBABLY never before in history have people been so concerned about what they should or should not eat as they are today. Now, however, Dr. Harrison E. Howe of the National Research Council warns us that the concern of the immediate future will be not so much with what we shall eat, but how to get enough to eat.

By 1950, he says, the United States will have about 150,000,000 people to feed. The needs of such a population will require the tilling of at least 38,000,000 more acres of land than at present. And to add to the problem, the vitality of the soil now under cultivation is decreasing steadily.

Uncle Sam, warns Dr. Howe, must make rapid strides in the science of soil conservation to meet the coming need for vastly larger crops.

Father and Daughter Scientists War on Mosquito

Two scientists, father and daughter, are engaged in warfare in London against one real enemy of their country—the mosquito. Moore Hogarth, of the College of Pastology, is carrying on the campaign, with his daughter as assistant and microscopes and test tubes as weapons

We're Immortal—Potentially

WHY do we need to die?

Interest in this age-old question has been renewed with the discovery, by Professor Max Hartmann, of Berlin, of a microscopic one-cell creature which apparently can be made to live forever By careful treatment, which includes pruning off portions of the creature's body at intervals, Professor Hartmann claims to have kept it alive for many times the length of its normal life. If the same results could be obtained with human beings, he says, our lifetime could be extended indefinitely.

Married Men and Old Maids Make Best Workers

WHO are the best office workers? "Married men and old maids," answers Hubert D. Brown, chief of the United States Bureau of Efficiency, from his experience with employees in Government offices. "Bachelors and boys, married women and flappers are not so good."

The Government, he has found, has no better employees than married men, probably because they have learned the art of give-and-take from married life.

The old maids are ideal, he adds, because woman's efficiency increases as the thought of marriage fades—"she mothers her job."

Flappers, he contends, let their minds wander, think too much of men, stop work to powder their noses, and constantly "flit about."

Mr. Brown observes further that widows are unsettled and easily disturbed.

Vindication for Meat Eaters

SCORE one point in favor of the meat eaters. After a thorough physical examination of Vilhjalmur Stefansson, a Chicago physician reported that the famous Arctic explorer was in exceptionally fine physical condition despite his exclusive meat diet while in the Far North.

"Neither Stefansson nor any of his men, so far as we could determine, suffered any ill effects from long-continued meat diet," says the report of the examining physician.

AN UNUSUAL development in aviation which comes from Germany is a new type of motorless glider, designed to imitate the structure and soaring action of large birds. Its wings are jointed, and it is much larger than previous types of gliders.

It Detects Finger Prints You Can't See

Finger prints that can't be seen with the eye may yet prove strong evidence against criminals, as the result of a chemical machine invented by Arthur E. Bergquist, of Lindstrom, Minn. It is said to detect and develop marks on paper, leather, or cloth. A police official is shown above using the device, the top picture showing prints brought out on leather bag. Turning a crank operates it

When All Things Are Possible

Miracles of our times seen as products of the spirit of mechanical ingenuity—Wonder stories of the stars and sea—Reviews of fascinating new books

By THOMAS M. JOHNSON

"Our Times"

By Mark Sullivan. Published by Charles Scribner's Sons

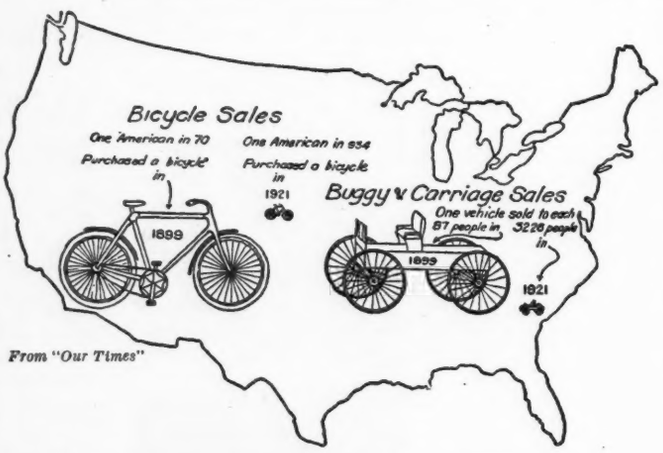
"IT'S impossible—it can't be done!" How often, in the world's history, have people said that! We say it less today, perhaps, than ever before—the "impossible" has been accomplished too often, right in our own time and before our own eyes. But it is a tricky lesson to learn.

We take automobiles for granted today. Last year there were 17,000,000 of them in the country. If anyone had predicted this at the turn of the century, he would have been laughed at.

The first automobile appeared in America in 1892, and in 1895 there were just 300 of them. Here is what the *Literary Digest* said in 1899, according to the first volume of *Our Times*, Mark Sullivan's series depicting recent history.

"The ordinary 'horseless carriage' is at present a luxury for the wealthy, and, although its price will probably fall in the future, it will never, of course, come into as common use as the bicycle."

In that year, one American in seventy bought a bicycle. In 1921, only one American in 934 bought one! This amazing change has been brought about, Mr. Sullivan believes, by the vision and ingenuity and energy of ingenious Americans who kept forever tinkering until they had made automobiles that almost anyone could own and drive.


Bicycle Sales
One American in 70 Purchased a bicycle in 1899
One American in 934 Purchased a bicycle in 1921
Buggy & Carriage Sales
One vehicle sold to each 87 people in 1899
One vehicle sold to each 3226 people in 1921
From "Our Times"

In 1899—to complete this graphic illustration—there was one automobile to every 23,700 of us; in 1921, the ratio was one to every eleven!

IN MANY American towns and villages the local mechanical genius—sometimes the local "nut"—devoted his whole being to this new European device. The first stage of the automotive industry in America was that of isolated persons, each making a single machine.

Ford was a mechanic in an electric power house, Winton was a bicycle repair man, Franklin was a die caster, Pierce made bird cages, bicycles and refrigerators, and Haynes was field superintendent of a natural gas company. The Studebaker car was the product of a wagon factory, the Peerless of a clothes wringer factory and the Stanley was developed in a photographic dry-plate factory.

The same sort of ingenious, tinkering Americanism, in the person of the Wright brothers, working in a small town bicycle shop, developed the airplane.

On October 23, 1903, Mr. Sullivan points out, the brothers made their first airplane flight at Kittyhawk, N. C. Before that, however, Dr. S. P. Langley, secretary of the Smithsonian Institution at Washington, had built a machine and tried to fly it. After many unsuccessful attempts that drew public attention, he was ponderously rebuked by some magazines for wasting his time. But in 1914 his machine was dusted off and successfully flown by Glenn Curtiss. Again the impossible had been accomplished.

Even in "up-to-the-minute" New York, there were men not so long ago who said "impossible," Mr. Sullivan reminds us, and retarded the building of subways. When in 1896 the New York courts had refused to approve a subway project, the decision said: "The probabilities indicate that, after sinking $51,000,000 in it without being able to complete it, the enterprise would have to be abandoned. All that beheld it would begin to mock, saying 'this city began to build and was not able to finish.'"

Nor did anyone then foresee radio as we know it today, with more than 3,000,000 receiving sets in the country.

All these developments of the turn of the century have been in large measure the work of men who temperamentally could never agree with a majority that said, "This thing is impossible."

"The Music of the Spheres"

By Florence Armstrong Grondal. Published by the Macmillan Company

WHAT are the stars? Are they other worlds? Of what are they made? Why do they twinkle? We are all star gazers sometimes, and to us all these questions have come.

Some of them at least are answered in a new book, *The Music of the Spheres*, that tells the results of the latest astronomical research in a way that the average reader will find easy to understand.

A star's nucleus is formed by gas at high pressure, gathered together by gravity and condensed into a glowing ball, so that stars when young are huge and red. As stars contract, they rise in temperature, but when too advanced condensation retards this contraction, the star cools.

How large are the stars? The diameters of a few have been measured and found to vary from a few thousand miles to a good many million. Our sun is only a medium-sized star, and its diameter is 866,000 miles.

What are the stars? Mrs. Grondal defines it this way: "The stars are distant suns, and the sun is a nearby star."

Interest in the planet Mars has always been strong, and Mrs. Grondal tells the latest theories of some authorities regarding it. They believe, she says, that Mars is an old planet whose water is rapidly disappearing, so that soon the planet will become a desert. There are, however, snow caps at either pole which melt in the summer. The water is guided to points where it is most needed, by the famous "canals."

No less interesting is what Mrs. Grondal says of the moon. The gray areas on the moon which we can see with the naked eye are not seas but probably lava plains. The yellow or green tints revealed by the telescope may be due to vegetation or colored volcanic material. There are more than 100,000 craters on the moon visible from earth.

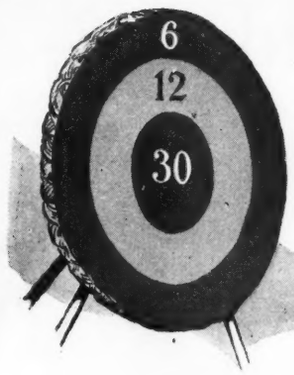
The men in the moon—if there are any—Mrs. Grondal explains, would be one sixth as heavy and able to jump six times as high as anything earthly, because the surface gravity of the moon is only about one sixth that of the earth. But if there is a man in the moon now, he must be unhappy, for the planet is nearly dead and lacks air, water, life and even sound!

"The Arcturus Adventure"

By William Beebe. Published by G. P. Putnam's Sons

A TREASURE ship sailed into New York harbor not long ago—such a treasure ship as had never been seen before. It brought back bright jewels from the deep sea, and from strange islands of the Pacific, and from the Sargasso Sea, once known as whirlpool of missing ships.

The homecomer was the *Arcturus*, sometimes called a "floating laboratory." It was fitted out by William Beebe, tropical research (*Continued on page 163*)



For Mental Sharpshooters

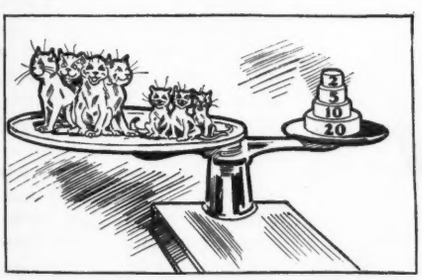
WHAT is the fewest possible number of shots which this archer can score on the target to produce a total that will average seventeen points to the shot—all shots to score? If you have a "good head for figures," you should be able to perform this mildly mathematical feat in six minutes. The answer appears on page 164.

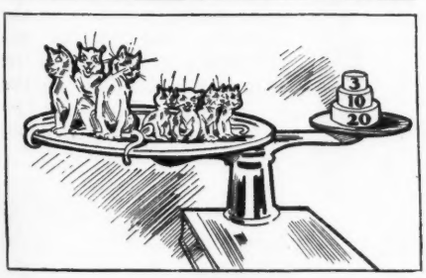
These Sam Loyd tests are appearing from month to month in POPULAR SCIENCE MONTHLY in response to requests from many readers. They are the best that the master puzzler can offer

Six Ways to Test Your Mind

These Sam Loyd Puzzles Challenge Your Brain Power and Offer Stimulating Entertainment

IN THE six tests on this page Sam Loyd, the world famous puzzle expert, shows you how you can get a line on your mental equipment, and at the same time have a lot of real entertainment in doing it. In the form of challenging puzzles he offers a new and fascinating way to measure your brain power and put an edge on your wits. The problems are of different types, each calling into play some one of your mental faculties. A time limit adds the zest of competition.

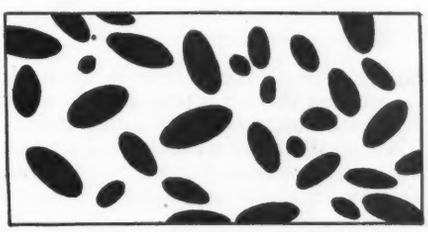




Do You Think Quickly?

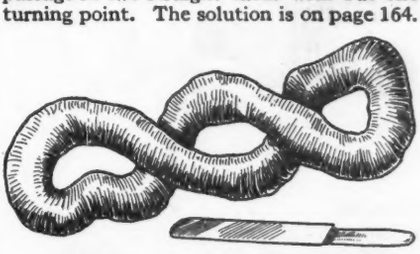
FOUR cats and three kittens weigh as shown in the upper sketch. Another lot, consisting of four kittens and three cats, has another weight. Now, if the cats all weigh the same, and the kittens likewise, what are their respective weights?

If you reason logically and swiftly, three minutes will yield the correct answer, which appears on page 164.



This Takes Sharp Eyes

IF YOU are good at taking short-cuts, and if your eyes are accurate guides, you should solve this in four minutes. The sketch represents a reef-strewn zone. You are to discover a route from the top line of the rectangle which makes a straight run to one of the side lines and thence straight to the bottom line. This would admit of a ship's passage in two straight tacks with but one turning point. The solution is on page 164.



Food for Your Ingenuity

INTO how many pieces can you cut the doughnut by drawing mentally one straight line across it? Here's a test of your ingenuity and sharpness of perception. Three minutes is a reasonable time allowance for quick wits. Turn to page 164 for the solution.

A New Test for You

Don't miss the remarkable new game which will appear in next month's issue. It's simple, yet scientific.

Are You Clever with Words?

IF WORDS come quickly at your command, and if you're resourceful in finding the right word for the right place, ten minutes of mental gymnastics should solve this one:

A certain letter, when sprinkled through the following line, will turn it into a complete sentence:

A D E N I I C A N D O C K

It is necessary to use the letter several times in forming the words of the sentence. You'll find the answer on page 164.

Have You Imagination?

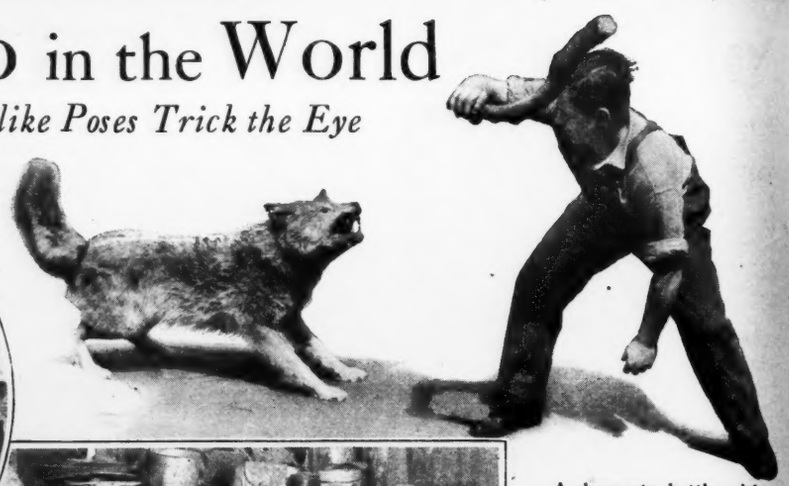
CAN you translate into English these pictorially expressed "good resolutions," and do it in ten minutes? If so, wit and imagination will be strongly indicated in your mental make-up.

Just for a starter, each one of the resolutions begins with the word "Be." Now see how quickly you solve them; then compare your solutions with the answers on page 164.

The *Tamest* Zoo in the World

Where Animal Skins in Lifelike Poses Trick the Eye

Ostriches lined up for a race—but they'll never get past the starting point, for they're only products of skilled taxidermy, produced by one of the Sauters



A desperate battle with a ferocious wolf? It looks like it—but it's only young Fred Sauter, posed with one of his own remarkable creations

CROUCHING wolves with snarling fangs bared, that remain curiously still, however, and never leap;—racing ostriches with craning, straining necks, that nevertheless are lifeless to your touch—these are some of your curious impressions when you visit the strange menagerie of Fred Sauter and his son, in New York City.

The Sauters are taxidermists of extraordinary skill and originality. The elder Sauter learned the profession from his father, and the son is preparing to carry on the business after his father retires. Their creations are so lifelike that nervous visitors sometimes jump, thinking the animals are about to spring at them.

Theirs are no conventional mountings, made in conventional poses. They have studied the animals themselves—and birds and fishes, too. They have learned their mannerisms and instincts—how they fight, eat, play. With care and skill they reproduce these attitudes.

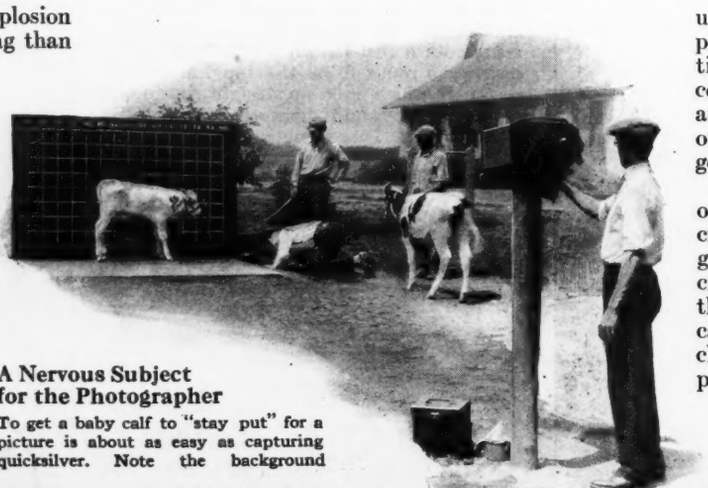
The lower picture shows the stages in a deer head mounting. First Sauter makes the head outline of wood; next he attaches the antlers and head skin. Then he thickens the neck with straw and twine, and last puts the skin over that.

Calves Pose for Camera to Develop the Perfect Cow

"SHOOTING" a dynamite explosion isn't any more nerve racking than photographing a nervous calf, say the government cameramen whose job it is to photograph animals during scientific breeding experiments. Pictures of this kind have no value unless the calves are photographed to an exact scale and in identical positions, which it is most difficult to do.

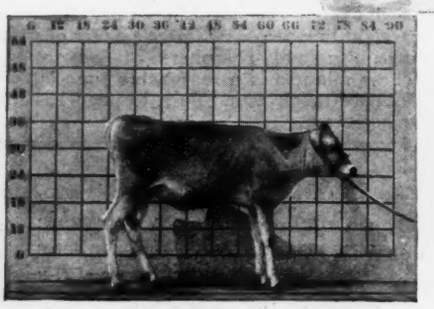
According to the method worked out by the Department of Agriculture, the calves are posed against a background carrying a scale ruled in squares. Pictures are taken of each animal once a month until it is fully grown. Comparisons enable the scientists to note the relative conformation and growth, and furnish valuable records through succeeding generations.

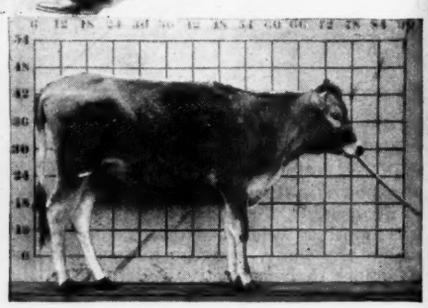
The camera is set on top of a post planted in a concrete base, and the background is built on a concrete platform. This makes the distance between the camera and animal unchanging, so that all of the pictures are taken on the same scale. The pictures are used to guide cattle breeders.



A Nervous Subject for the Photographer

To get a baby calf to "stay put" for a picture is about as easy as capturing quicksilver. Note the background





Three pictures of the same animal, taken at twenty-three days, five months and one year of age. Against the same background and always in the same pose, the pictures revealed changes in growth, such as, for example, the slope of the back

Now They Grow Oysters *on* Trees

Discovery of Surprising New Way to Raise Bivalves Saves a Vanishing Industry

Section of sewer pipe to which young oysters attached themselves, in tests to find the best means of raising them

Planting "oyster trees"—birch brush—in shallow tidal water. Each twig will easily provide a home for hundreds of future oysters

Herbert F. Prytherch (above), of the U. S. Bureau of Fisheries—the man who developed the "oyster tree" idea

IF YOU happen to walk on an ocean beach at low tide and see a gang of men working with a scow-load of shrubs don't laugh if someone tells you the men are planting "oyster trees"! For that is exactly what they are doing.

Growing oysters on trees is an accomplished fact, though quite new. The oysters that you eat for dinner very likely spent their youth clinging to the twig of a birch in the shallow waters of a tidal flat.

The development is part of a scientific program for making sure that your grandchildren, too, will have oysters for dinner. The oyster population has a heavy death rate, and several other influences have so devastated the supply of bivalves that the Government feared it would be exhausted.

Oysters form the basis of the most valuable fishing industry in the United States, with an annual return of nearly $15,000,000 to fishermen. It was thought worth while to save it, and the best way to do it was to provide a suitable place for baby oysters to develop and reach maturity.

When from fourteen to eighteen days old, oyster larvae attach themselves to a smooth surface and remain fixed. The face of a submerged rock is a favorite resting place. A common practice of oyster growers has been to plant empty oyster shells. Other types of "support" or "collectors" have been tried, including split drainpipes, flowerpots, tiles and stakes. But birch brush, the U. S. Bureau of Fisheries found, provides the best anchorage of all.

Birch brush with its numerous branches provides abundant parking space. A single birch brush may become an apartment house for thousands of future oysters. It is lifted out of the water easily, too.

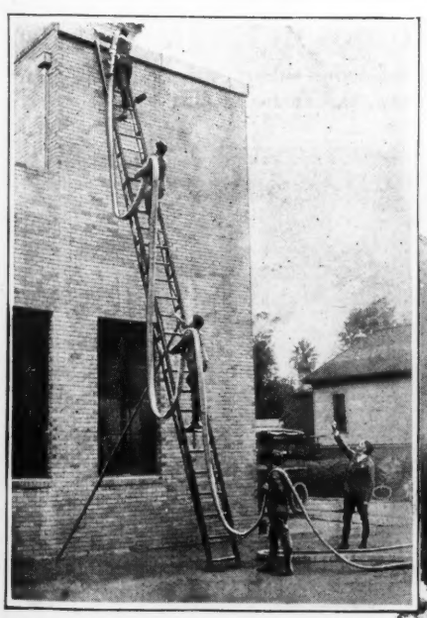
Within a few years the American coast will probably be lined with submarine forests of oysters.

Boy Scout Firemen Aid in Thrilling Rescues

ANY boy who longs to be a fire fighter and help in thrilling rescues can be one now—if he is a Boy Scout and if his city fire department has one of the recently instituted Boy Scout Fire Auxiliaries.

Scouts in several cities are doing valuable work in aiding the regular fire departments in this way. Besides putting out brush fires, they turn in alarms, report fire hazards, and at big fires assist in holding back crowds, helping with the hose and cleaning up. The scout firemen are equipped with badges that permit them to go through fire lines. They report to the highest fire department official at the fire for orders, but are not allowed to enter a burning building or risk their lives.

The boys are organized into companies and have regular hose and ladder drills.



Boy scout fire auxiliary, Pasadena, Calif., learning to handle ladder and hose

Soft-Drink Server Keeps Bottles Ice-Cold

Putting a warm bottle at one end pushes out a cold bottle at the other, making it unnecessary to open the ice box

ICE-COLD soft drinks at any time come out of the automatic server illustrated here. As you put in a warm bottle at the right end, you automatically push out an ice-cold bottle at the left end. The bottles travel through an ingenious arrangement of U-shaped tubes from one side of the cooler to the other. There are eight tubes for eight different flavors of drinks, each tube holding nine bottles.

The tubes pass through a cork-insulated chamber filled with ice. Since the cooling chamber is opened only for refilling two or three times weekly with ice, the ice, it is said, lasts considerably longer than in an ice box.

Soda fountains and wayside drink dispensers using this unique new drink server find it more sanitary than the usual type of ice box, where the bottles come in direct contact with the ice. The bottles come out uniformly ice-cold, too, not sometimes lukewarm.

Odd-Shaped Tool on Key Ring Does Several Jobs

FIVE tools in five different places aren't half as useful as five tools in one place, always where you want them. The tool above combines a bottle opener, a wrench for one eighth inch to one half inch round or square parts, a screw driver, a presto key and a key ring, made of hard steel.

Camera Shows Errors in Acting

IN TEACHING stage technique at the Eastman School of Dramatic Action, Rochester, N. Y., the camera plays an important part. In this school the art of acting for the legitimate stage is taught in all its phases, each step of the training augmented by moving pictures made to show the student's errors and progress.

When the student first enters the freshman class, he must register, in front of the ciné camera, certain assigned emotions. Later he sees himself on the screen, and the instructor points out methods for improvement. Every three months thereafter new films are made.

Several plays are staged for public performances during the school term, films being made of the entire action at rehearsals. These films serve as the basis for corrective criticism.

New Type of Violin Bow Plays All Strings at Once

ALL four strings of a violin, as well as three or two of them, can be played simultaneously with the strange bow illustrated at the right. The bow, invented by Herman Berkowski, of Berlin, Germany, is flexible and bends almost in a semicircle over the violin. As shown in the picture, the little finger of his right hand manipulates a lever which loosens or tightens bow strings while he is playing.

Many striking chord effects can be produced with this unusual bow.

His little finger adjusts the bow string

Magnet Separates Metal Scrap

BY MEANS of a magnetic device for separating iron and steel from monel turnings, the General Electric Company, Schenectady, N. Y., saves $20,000 annually in disposal of scrap. A rheostat reduces the current to a point where the metal is picked up and the monel dropped.

Make Maps Directly on Metal

CHARTS and maps are now being engraved in metal by a new method devised by the hydrographic office of the U. S. Navy Department. The process permits the engineer to compile charts on metal printing plates without the necessity of preparing a finished drawing.

The Predecessor of Your Saw

The stone is chipped to form sharp teeth

A SURVIVAL of the Stone Age, when man killed game with spears or arrows tipped with flakes of flint, skinned his trophies with jagged bits of rock, and sewed his fur garments with fish-bone needles, is found in this curious Maori stone saw made by a New Zealand native.

Blade and handle are shaped from stone, and the cutting edge is chipped to serve as teeth. It was from such beginnings as this that modern saws developed.

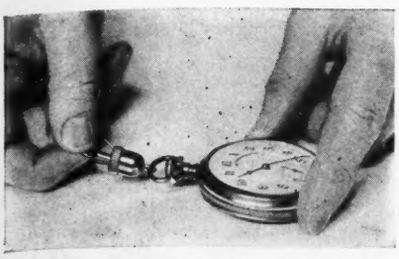
Hot Meals Delivered to Homes in England, Too

ENGLISH housewives, like their American sisters, are being relieved more and more of the duty of preparing meals by caterers who do the cooking for half the neighborhood.

A caterer in the town of Finchley does such a flourishing business that he undertakes to deliver orders two hours after they are received.

He packs the soups, meats, vegetables and desserts in separate containers, which fit snugly, one above another, in a tall insulated can, as shown in the picture. They are still piping hot when delivered. More than 5,000 families in this London suburb, it is said, have their meals sent home in this way.

Delivering hot meals to homes in Finchley, England. The tall cans contain receptacles for soups, meats, vegetables and desserts



Prongs Foil the Watch Thief

A SMALL but mighty enemy of the watch thief is this gold watch guard resembling an acorn, attached between the ring of the watch and the watch chain. A jerk on the chain brings out three prongs which catch in the pocket and prevent the watch from being pulled out easily.

Build Fences to Test Paint

FULLY $2,000,000 is spent for paints every working day in the United States, according to the Engineering Foundation's committee on wood finishing research, of which A. H. Sabin, of New York City, is chairman. Last year the nation spent $600,000,000 for paint. And more than half the painting was done by nonprofessionals.

"Test fences" of sixteen different kinds of woods are now being erected in different parts of the country, to study the effects of paints and varnishes on them. Each fence has sixty-four panels, representing sixteen kinds of wood. The tests are being carried on by the Bureau of Standards of the Department of Commerce.

Such fences have been erected in Madison, Wis.; Fargo, N. D.; Milwaukee, Wis.; Palmerton, Pa.; Sayville, N. Y.; Washington, D. C.; Gainesville, Fla.; Grand Junction, Colo.; Tucson, Ariz.; Fresno, Calif.; and Seattle, Wash.

Move Ancient House 35 Miles

STICK by stick, a 200-year-old house was moved recently from Southbury, Conn., to Noroton—a distance of thirty-five miles. Dr. and Mrs. L. T. Swift took a fancy to the house, engaged a builder to take it apart, move it, and reassemble it.

Plywood Crates Save Padding the Furniture

MARRED, broken or scratched furniture sold at reduced prices at freight sales testify how hard it is to pack furniture so that it will ship safely. Ordinarily, large pieces are shipped in crates built of slats, making it necessary for the furniture to be wrapped and padded carefully.

A new shipping box has now been designed to overcome some of these objections. It is made of plywood. Single panels of this lightweight wood form the sides of the crate, covering the furniture completely and leaving no seams or cracks through which dust and rain may seep. Consequently no padding is necessary, and the packing men can do their job in considerably less time. According to its designer, the crate touches the furniture in only two places—the back and bottom, both unfinished surfaces.

Courtesy Atlas Plywood Corp'n

There are no seams or cracks through which dust and rain might seep, and the same crate can be used several times

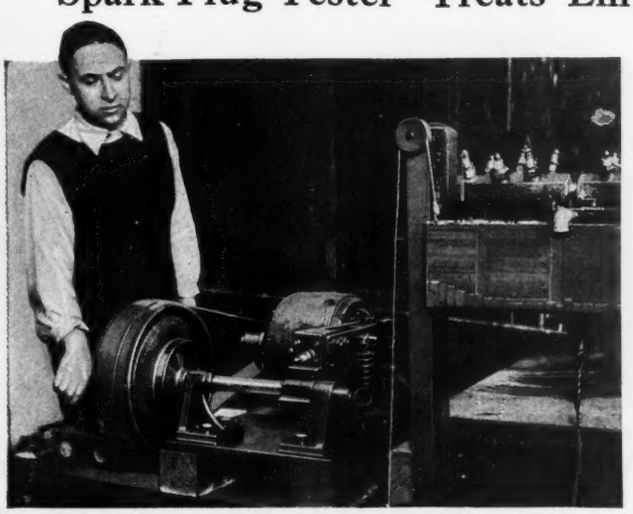
The right hand keeps striking the "type key" as the pointer is moved from letter to letter. The other key used is the word-spacing key

Typewriter Has Only Two Keys

IN PLACE of the alphabetical keyboard of the ordinary typewriter, the new machine at the left operates by the simple means of moving a pointer with the left hand and pressing two keys with the right hand.

At the left of the machine is a plate showing the letters. The operator moves a pointer to the letter he wants, simultaneously striking the "type key" with his right hand. This single "type key" prints whatever letter the pointer points to. By rapidly shifting pointer from letter to letter, simultaneously striking the "type key," the typing is done. The other key used is the word-spacing key.

Spark Plug Tester "Treats 'Em Rough"



Hammering and compression machines reproduce the conditions of rough usage to which the average spark plug is subjected

TO PROTECT motorists from trouble due to weak spark plugs, the United States Bureau of Standards in Washington is giving spark plugs severe tests with an automatic vibrator. C. H. Roeder is shown here operating the testers.

The device at the left hammers the plugs several hundred blows a minute. Those that survive this are then tested by the machine at the right for leakage.

Three-Wheel Skate Has Rubber "Cushion" to Save Bumps

TURNING sharp corners on high is possible with the new type of roller skate shown below. It has only three wheels, a pair in front and a single one of smaller size under the heel. Answering the same purpose as shock absorbers on a car, there is a rubber cushion under the heel plate to take up the bumps of the road and to "cushion the driving force."

Rubber cushion under heel absorbs shocks

All three wheels are rubber tired and ball bearing, containing two rows of balls. They are of the steel disk type, the front wheels being four inches in diameter; the rear one less than three.

The novel cushion application is intended to make the new skates less tiring than the ordinary roller skates.

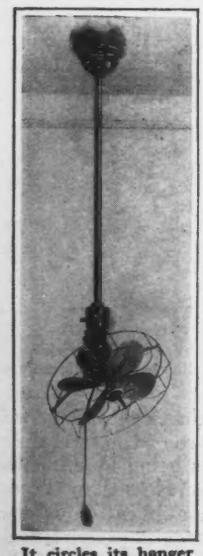
It's Easy to Pick Your Club from a Golf Bag Like This

OPENING down the long side, the new type of golf bag shown above completely exposes all the clubs, making selection of clubs easy. When the bag is closed, it locks automatically. Rings hold the clubs in place so that they cannot slip out, no matter at what angle the bag is held. Each club is kept separate from the others and golf balls, too, may be carried in the bag.

In appearance the new bag is similar to ordinary types, the difference being a metal skeleton with special rings and clips for holding the balls and clubs.

Ingenious Violin Plays Itself

AFTER working on the problem for fifteen years, two French technicians, it is reported, recently completed the "Violonista," a device that imitates mechanically the playing of a violin. The machine uses a real violin and bow, and can be synchronized with a player piano.



It circles its hanger five times a minute

Ceiling Fan Swings Around in Circle

EVERY person and every corner in the room gets a bit of the breeze from the new rotating electric fan shown at the left. It is a ceiling-type fan, mounted at a 45-degree angle, and is geared so that it rotates completely around its hanger, throwing breezes in all directions and cooling a circle twenty feet in diameter. The rate of rotation is about five times a minute.

Modern Magic Lamp Betrays Frauds

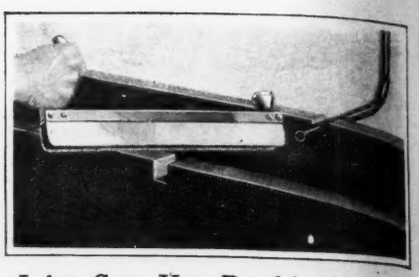
THROUGH the invention of a remarkable quartz lamp recently in Germany, it is now possible to detect, quickly and easily, frauds not only in pearls and wool fabrics but also in stocks, bonds and paper money.

The new lamp utilizes the well-known power of ultra-violet rays to produce different tints and degrees of brightness in different materials. By this means, it makes it possible to distinguish immediately between animal and mineral matter.

If you hold a pearl under the rays of this lamp, according to reports, it will betray instantly whether the pearl is real or synthetic. And if you want to determine whether a fabric is really all wool, the lamp will instantly show whether cotton threads are present.

Under its rays, counterfeit stocks, bonds and paper money are detected easily, for the slightest difference in the composition of the paper shows in a difference of color under the ultra-violet light. It also reveals erasures or changes.

Old parchment manuscripts, long undecipherable, may now be read. Parchment is of animal origin, and the stylus and inks were mostly mineral. The chemical action resulting can be traced under ultra-violet rays, though the original writing may have been erased with pumice stone!



Joist Saw Has Double Blades

MAKING both cuts at the same time, to the same depth and in one operation, this new joist notcher is designed to save time and labor. The two saw blades are parallel, and the tool operates on the principle of a plane. Weighing only two pounds, it is easy to handle.

New Paint Resists Even Acid

ELATERITE, the substance forming the base of a remarkable new paint, is a hydro-carbon deposit found in commercial quantities only in Utah. It was only recently that a formula was found making this amazing product available in the form of paint.

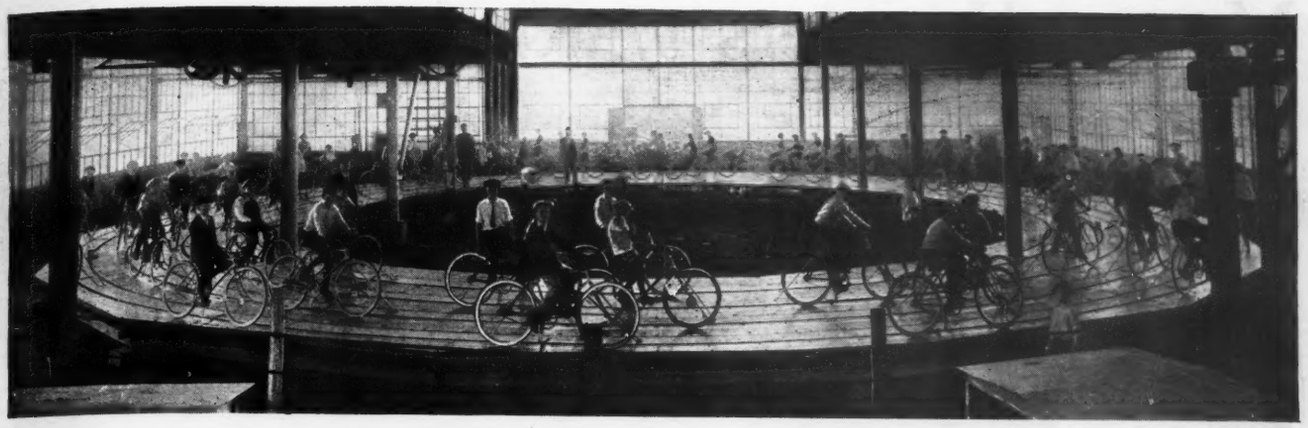
Materials coated with it, whether wood, metal or concrete, are said to be proof against the destructive action of acid, alkali, water, oxygen and nitrogen. After the paint has been applied, the solvents evaporate, leaving a solid, completely poreless veneer.

500-Ton Excavator Rolls Easily on Caterpillars

Almost shoulder-high to a man, huge caterpillars propel this million-pound giant safely even over soft ground

IT IS only within the last twenty years that excavating machinery was first mounted on caterpillars. Today almost all of the smaller shovels are equipped with this type of mounting, and the successful mounting recently of a 500-ton shovel indicates that it is just as practical for the giant machines.

In spite of its tremendous weight of a million pounds, this new machine propels itself across soft ground without difficulty. It is mounted on four units, each made up of two caterpillar belts a yard wide. It turns corners easily compared with truck-mounted machines.



Bike Races on Spinning Runways Thrill Amusement Parks

THRILLS and fun and lightning speed racing are in store for visitors to amusement parks where the brand-new bicycle ride above, just invented, is being installed. Sixty bicycles set on four moving runways speed on stationary steel platforms. The rider pedals his bicycle as he would on the street, but goes much faster, since at the same time the vehicles are spun around the circle by motors. Riders can race those on other tracks, though of course the inner and shorter tracks have an advantage. This newest thriller has had safety tests and is said to be both fool-proof and accident-proof.

More Work for Safe-Crackers

SAFE-CRACKERS will have to apply their ingenuity to overcoming still another obstacle, if the concrete safe introduced in Paris becomes generally adopted.

This safe has an outer wall of solid concrete; consequently, it is said, there is no danger of demolition by fire or from the application of chemicals. It has a central core of steel, reinforced with a solid wiring of steel, and the concrete is placed around this material.

Protecting the Tunnel Autoist

CARBON monoxide, the poisonous constituent of automobile exhaust gases, presents a serious problem to the designers of vehicular tunnels. Where traffic will be heavy, as in the vehicular tunnels under the Hudson river at New York City, now nearing completion, special precautions must be taken.

A new apparatus now protects motorists by measuring the amount of the poisonous gas present in the tunnel. It is said to be the most sensitive instrument known for determining carbon monoxide, attaining the sensitivity of one part per million. It was devised by chemists of the Bureau of Mines.

Odd Camera Doesn't Need Films

INSTEAD of taking pictures on films, the novel camera above takes them on sensitized cards which give you finished pictures a few minutes after exposure. At the back of the camera is a light-proof sleeve, through which you insert the cards. After exposure the card is put in a developing tank, which is part of the outfit. In a minute or two the card is removed and immersed in water, and the picture is done.

New Idea for Battery Charging

A SIMPLE oxidized surface of copper could replace vacuum tubes, acid solutions, or mechanical vibrators in current rectifiers, which change alternating into direct current for charging storage batteries and operating radio sets, according to L. O. Grondahl, of New York.

By subjecting metallic copper to high temperature, oxide of copper forms on its surface. Grondahl has found that this layer allows an electric current to pass through it in one direction only. If an alternating current is passed through, he says, it is changed into a current which flows only in one direction.

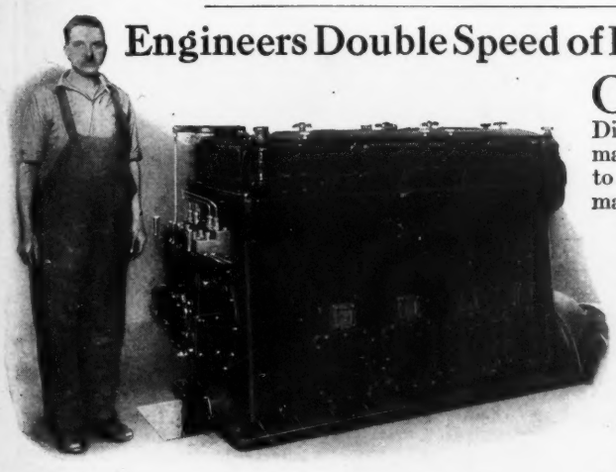
A Microscope for Everyday Use

FOR the amateur microscopist, the new pocket microscope illustrated below has several special advantages. The tube can be removed from the base and placed directly on the object to be examined, unlike the average microscope in which the object must usually be placed on a glass slide or card. A mirror ordinarily underneath the "stage" of the microscope may be placed above it when the base is removed, to throw reflected light down on the object.

Though inexpensive, the new instrument has a wide range of magnification.

Clothing, seed and fur salesmen should make good use of this little microscope

Engineers Double Speed of Diesel Engine



Looking at it from the outside, you mightn't know this was a Diesel engine. The complete inclosure is a new feature of such apparatus

OPENING new fields of application for Diesel engines, the new machine at the left is said to be the only one on the market of its kind especially adapted for power wheels, cranes, industrial locomotives and so on. Its speed range is approximately double that of others, while its weight has been reduced proportionately even more. It is also novel in being completely inclosed and in being lubricated automatically.

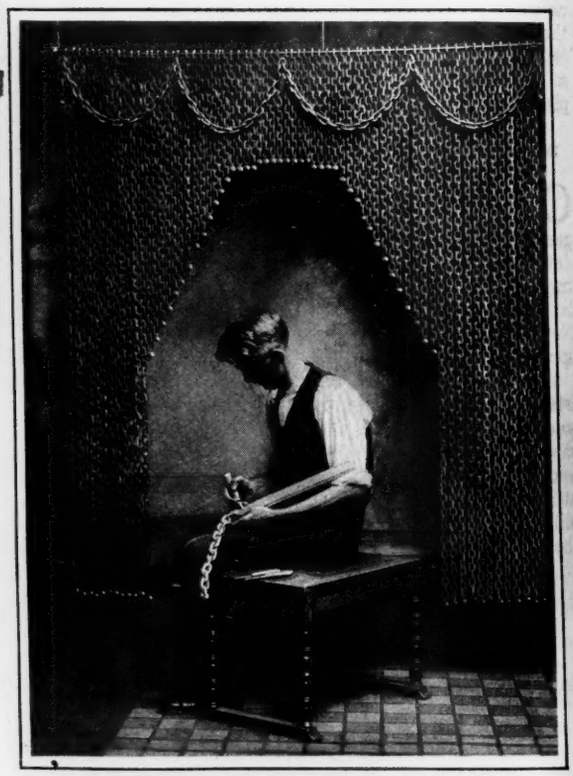
Master Wielders *of* Knife *and* Chisel

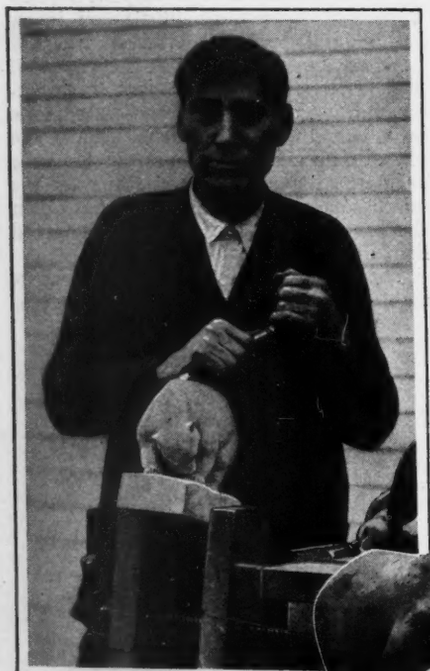
Schoolboy Sculptor Amazes Experts

Like other boys, he started "just whittling" scraps of wood, anything he could find. But Everett Dupen, above, of Los Angeles, had more skill in his finger tips than most boys and he kept at it until, at thirteen, he has carved figures causing wide comment. Sculptors and artists of national reputation have examined and praised his work. He is shown here putting the finishing touches to a wooden figure of Joan of Arc. On the table are also a Viking ship, figures of a Greek javelin thrower, a man playing a harp, a horse, an Indian and a tiny bust of Dante

Famous Artist Has Carving For Hobby

Three years ago a friend of Mark Fenderson, well-known artist, of New York City, gave him a discarded wood carving bench. Mr. Fenderson began playing with the tools, with the result that illustrating in wood soon became an absorbing hobby. He uses solid oak with dovetails and pins, no nails or screws. His furniture is distinctive because of its unique pictorial decorations. Bugs, bats, Indians (as in the cabinet door at the right), angels, witches, and grasshoppers dance on his pieces. An old-time circus parade and a "Covered Wagon" procession adorn others





Indian Stalks Wild Beasts to Model Them

Seated out in a lonely forest, motionless as part of the landscape, an Indian sculptor of the Far West watches for hours the wild beasts that still haunt these regions. Only the movement of his hands betrays that he is alive. He is John L. Clark, Blackfoot Indian, whose wood carvings of wild animals, made as he sees them at water holes or feeding and playing in valleys, are being shown in leading art museums. Practically all of his small figures are made with pocketknives—the picture at the left shows him putting finishing touches with a chisel, but the real work had been done with a knife

Right: Some of the Indian sculptor's pocketknife "whittlings" of soft white pine

Whittles Wooden Portiere of 3,000 Parts

This marvelous portiere is made entirely of chains of wood, 3,000 links altogether. It cost B. Larson, of Brooklyn, N. Y., only $32 worth of American walnut, but more than 2500 hours of patient labor. He whittled each chain from one piece of wood, without any breaks, using homemade knives. Larson offers to whittle a single huge chain out of a California redwood tree if someone will take the trouble to mail him one!

They Tried *the* Unusual —and Made Good

Homemade—But It Sweeps Clean

If the street cleaners don't pick up all the dust in August Bertram's neighborhood in Brooklyn, N. Y., he hops into the strange-looking vehicle above and does the job right. The 76-year-old inventor says that his machine does the work of six men. An old flivver forms the skeleton, and the motor running it turns a revolving brush creating a vacuum, and drawing dirt into a tank

"Here's the Icewoman!"

An ice company in Los Angeles wanted to find out why housewives weren't using more ice. Miss Fleeta Evans (above) volunteered to find out, and decided that the best way to do it was actually to deliver the ice herself. Now she is delivering lectures for housewives featuring ways in which ice can be used

Oldest Woman Telegrapher

Seventy years old, Mrs. Bella B. Toner (right) holds the distinction of being the oldest woman telegraph operator in the country. For fifty years she has been station agent at New Centerville, Pa. She uses an ancient "tape" telegraph instrument—so old that the railroad has only one other like it

A Back-Yard Goldfish Paradise

When this "farmer," above, goes out to work, he takes a net instead of spade and hoe. Mr. and Mrs. J. G. Gray, of Los Angeles, have a strange back-yard farm—their crop is goldfish. Fresh-water snails and water lilies are also grown in the tanks of concrete

She Pounds the Anvil

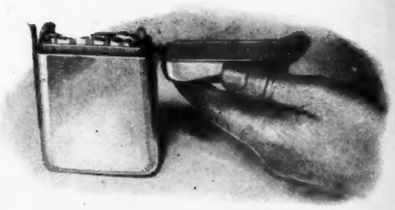
"The smith a mighty woman is she, with brown and sinewy arms." So say the school children of Marshall, Texas, as they pass the smithy where Mrs. J. A. Matthews (above) daily swings her twelve-pound sledge hammer. With the dexterity of a man, she shrinks wagon tires and puts them on the wheel. She's expert at shaping and fitting horse-shoes

Birds Out of Dried Gourds

Not wood or stone, but dried fruit, is the material used for "sculping" by Kaloo Patel, Hindu farmer, of Indore, central India (right). Out of gourds he models lifelike birds and fishes, by skilful trimming suggesting even the texture of feathers

Radio Set Built in a Baby Grand Cabinet

IT LOOKS like what it isn't—this deceptive piece of furniture shown at the left. A casual glance at it would tell you that it was a tiny baby grand piano. But it produces harp, clarinet and banjo music as well as piano—in fact, any music that happens to be broadcast when you tune in. On occasion, it is even a "talking piano," when the radio program schedules speakers. This unique radio cabinet contains a six-tube tuned radio-frequency outfit home-built, with cone loudspeaker. The top of the piano acts as a sounding board.



Keeps Swimmer's Smokes Dry

WHEN it is a risk to leave cigarettes or money on the beach, swimmers can now carry these into the water with them, in the special waterproof case shown above. There is a holder in the case for cigarettes and matches, but when money or jewelry is to be carried the cigarette holder is removed. The case is metal with a rubber piece fitting snugly in the top, and is fastened to the swimmer's belt.

Rope Shot Out by New Gun Aids Sinking Ships

IF THE seas are too heavy to lower lifeboats, rescues are often made by shooting life lines from the deck of the vessel standing by. A new type of line-throwing gun, small and compact, made to be shot from the shoulder like a rifle, was used recently in a spectacular rescue of sailors off the coast of England. As shown at the right, the line is contained in a cylinder at the end of the gun barrel.

A shot throws out the lifeline toward the sinking ship, uncoiling its full length despite winds

Build Huge Dam in Maryland

MUSCLE SHOALS will take third place in water power capacity when a tremendous development on the Susquehanna river in Maryland for the Philadelphia Electric Power Company is completed. The station will develop 350,000 horsepower, 90,000 more than Muscle Shoals.

A dam 4,800 feet long will be built across the river, making a lake covering 8,100 acres, which will completely submerge the little town of Conowingo, Maryland. Seven enormous water wheel electric generators will generate electricity which will be sent over a 220,000-volt transmission line to Philadelphia.

PRESSED flowers mounted on cards for botanical study are more durable if subjected to a treatment devised by F. M. Woodruff, curator, Chicago Academy of Sciences. Dipping in transparent liquid celluloid produces a permanent coating.

DISEASES of bees, fishes and plants, caused by protozoa, may be banished, it is said, by oxygen applied under pressure.

How Much Do YOU Know about Science?

THE following ten questions, each relating to some fundamental fact of science, were selected from hundreds sent in by readers. How many of them can you answer? Turn to page 165 for the correct answers.

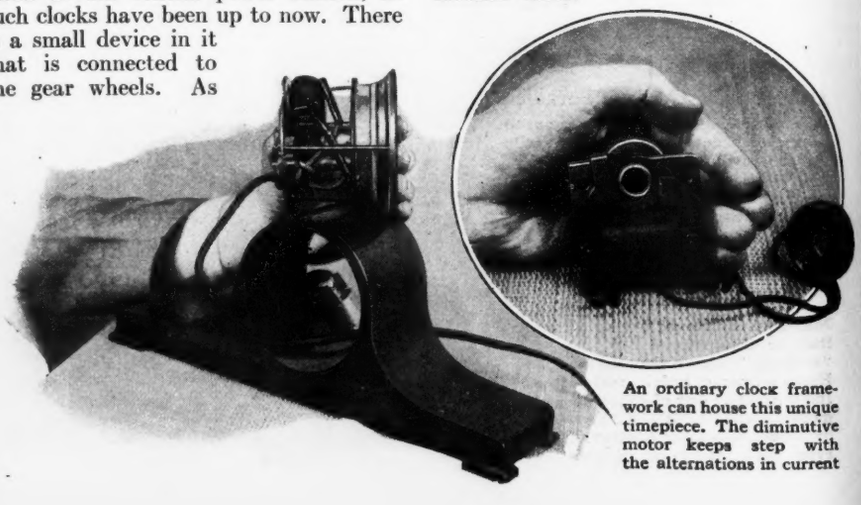
1. What is the so-called "second wind" of the athlete?
2. What muscles are used when you sneeze?
3. Why do we see small details that do not appear in a photographic picture of the same subject?
4. Why do some kinds of wood float while other kinds sink?
5. When can you see a rifle bullet while it is traveling through the air?
6. Why do some radio loudspeakers distort the music?
7. Why do nickel-plated surfaces sometimes rust?
8. Why does it take a long time to boil an egg on the top of a high mountain?
9. Why is a gas stove flame blue while a gas burner gives a bright yellow light?
10. Why is a differential gear needed in the rear axle of an automobile?

Novel Electric Clock Runs on New Principle

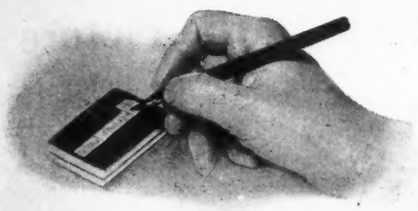
THE remarkable new electric clock shown below has no key because it never needs winding. It is simply connected to a light socket or wall plug. The current must be of the alternating type, as the clock will not run on direct current.

While electric clocks are not new, this one operates on an entirely new principle. It is not controlled by a master clock at the central power station, as such clocks have been up to now. There is a small device in it that is connected to the gear wheels. As the illustration shows, it looks much like the audio transformers used in radio receivers to amplify sound. Actually it is a tiny synchronous motor that always keeps in step with the alternations in the electric current.

Modern power plants regulate the frequency of the alternations in current so exactly that the clock is said to run for weeks or even months with only a few seconds' error.



An ordinary clock framework can house this unique timepiece. The diminutive motor keeps step with the alternations in current



Shows Where Your Money Goes

TAKING care of the pennies will take care of the dollars, the old copybooks advised. A pocket bookkeeper like the one shown above will tell you where the nickels and dimes go, too.

A ruled paper strip winds around a cylinder, and can be moved forward or reversed. The strip is ruled for date, item, amount received, paid, and balance.

His Barbed Wire Fences Relay Radio to Neighbors

BARBED wire fences can carry radio concerts as well as any other kind of wire. So a young farmer, Perry Brown, who lives in western Kansas, connected his receiving set to a barbed wire fence nearby and now entertains farmers for miles around. Similar connected fences stretch in all directions inclosing his land, and neighbors who want to hear the radio concerts have only to tap the wire. The dry cedar posts used in the fences insulate the radio current from the ground as it travels along.

Gramophone Has No Tone Arm

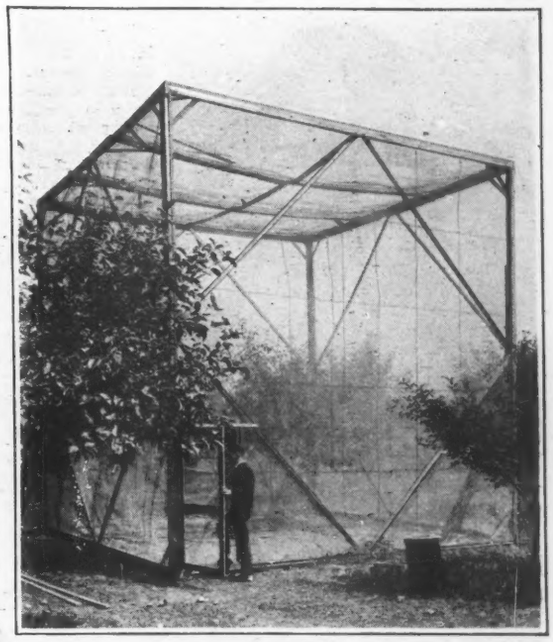
A NEEDLE, a cone and a record are all that is needed to make a gramophone, according to a recent invention of a professor of physics at Sydney University, Australia. No sound chamber, no arm for the needle, and no reproducer are necessary in its construction, it is reported. The cone is made of a special kind of Australian wood that acts as a resonator and is attached directly to the needle.

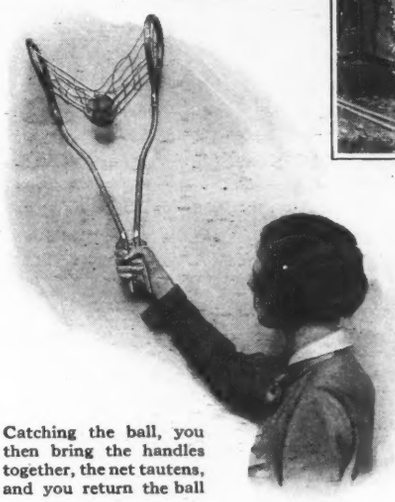
LIVE ELECTRIC wires strung through the trees are the latest means for fighting the destructive codling moths that infest the orchards and rose gardens of the Northwest, keeping off the pests with an operating time as brief as five minutes a day.

Pest-Trapping Cage Covers the Whole Tree

IN ITS fight against pest that destroy our fruit trees, the United States Department of Agriculture is trapping them in huge cages, as shown at the right, big enough to fit over a full-grown tree. Infested trees inclosed in the cages are sprayed with different kinds of material to determine the percentage of insects killed by them. The insects fall on canvas covering the ground in the inclosure and are identified and counted.

The cage, built in sections, is moved easily from one place to another.





Catching the ball, you then bring the handles together, the net tautens, and you return the ball

Tennis Handball—A New Game

FROM Europe comes a new game, something like tennis, something like handball, but actually neither. A light ball is used, and the player catches it in a net hung between two handles, as shown above. The handles are hinged, and when they are closed the net tautens and the ball is flung into the air.

The game is played with a court net as in tennis, scoring points each time the ball is missed.

Doctors to Learn by Movies

NEW discoveries in medicine, difficult and unfamiliar operations, and so on, are to be made into movie films so that physicians all over the country may study them, according to a plan of New York City medical authorities.

These films will form a "medical film library," and will aid small-town and rural physicians. Timing the slow-motion films just as deliberately as they wish, they will be able to see how certain new operations are performed.

Motor Bus Stores Passengers' Baggage on Roof

Built-in baggage compartments on the roof of this motor coach provide additional convenience for passengers on long bus trips

ONE disadvantage of traveling cross country by motor bus is that often you can't carry much baggage. In a motor coach route between Portland, Ore., and Seattle, Wash., however, space for luggage has been provided on the roof. There it is kept both dust-proof and weather-proof, packed away snugly in two racks.

Each rack is divided into two compartments. Baggage for more distant points can be segregated from the rest. Being distributed, the weight of the baggage eliminates strain on the axles, the additional weight itself reducing wind resistance.

KNOW YOUR CAR

WHILE the modern lacquer-type auto finishes are extremely durable, one substance in common use will seriously damage them. That substance is alcohol.

You can spill alcohol over the hood when you are putting in your winter supply and little damage will result if you have an ordinary paint and varnish finish, but spilling alcohol on the new lacquer finishes is sure to leave marks that cannot be eradicated by careful washing.

While the new methods of covering the surface of your automobile give you a finish that is durable, your car can be kept attractive much longer if you take care of it. Follow these simple rules:

1. Dust your car frequently and carefully.

2. Always use clean, soft rags for dusting.

3. Wipe off the rain drops with a clean piece of chamois after you have been out in the rain.

4. Polish the car after you have dusted it, using a piece of old silk cloth.

5. If you want to use a liquid polish, buy only the kind recommended by the manufacturer of the particular material used in finishing your car.

Movie Camera Runs Itself While You Act in the Picture

A famous actress—Billie Burke—making her own movies with the new camera

Right: The new movie camera. All you do is frame the scene in the finder and press a lever, starting the motor. Below: The projector for these films

AS EASILY as you make snapshots, you can make movies with this newly developed motion picture camera that weighs only five pounds. Run by a spring motor and loaded with 100 feet of film, it records more than four minutes of action.

It has a fixed focus, so no focusing manipulation is needed. Pressing a lever starts taking the pictures. There are two finders, one for making pictures at eye level and another when the camera is held waist-high.

Not only can you make movies with this new camera, but you can act in them yourself. To do this you simply set it on a tripod, start the motor, walk into the picture and take part in the action!

The same film that was used in the camera is also used in projecting the pictures on the screen. A new amateur projector will screen these films with an image of thirty by forty inches at a distance of eighteen feet.

Double Value from Gas Heat

MUCH of the heat wasted in gas cooking need not be lost but can be saved and used again, according to the inventor of an ingenious device made for this purpose. Excess heat from burners in the front of the stove is conducted to the back of the stove and used under other utensils. There is usually a surprising amount of such excess heat under cooking utensils, says the inventor.

Do Your Weeding Standing Up

The tool fits around the root of the weed

WEEDING and backaches go together—any gardener will tell you that. But that's if you stoop over and pull the pests by hand in the good old-fashioned way. A new way is to use a weeder that you work with your foot. The one illustrated has a curved iron cleft at the end, about six inches long, riveted to a long wooden handle.

The curved iron fits around the root of the weed and lifts it up. The tool is used like a spade, your foot pressing on a steel brace.

A Fascinating New Game

YOU can look forward to a lot of fun and fascinating competition playing the best game of the year, to be introduced in next month's issue.

This game is an entirely new discovery. It is as captivating as cross-words and as scientific as chess. There'll be cash prizes for the best players, too.

Rowing in the direction you are facing is quite easy, with these ingenious oarlocks. A bolt prevents slipping, and the device can be adapted easily to your old oars

You Face Ahead When Rowing with These Oarlocks

WITH your rowboat equipped with the curious oarlocks shown at the left, you can face the bow of your boat and look ahead in the direction in which you are rowing. There is no danger of the oars slipping from the locks, as they are fastened by a bolt.

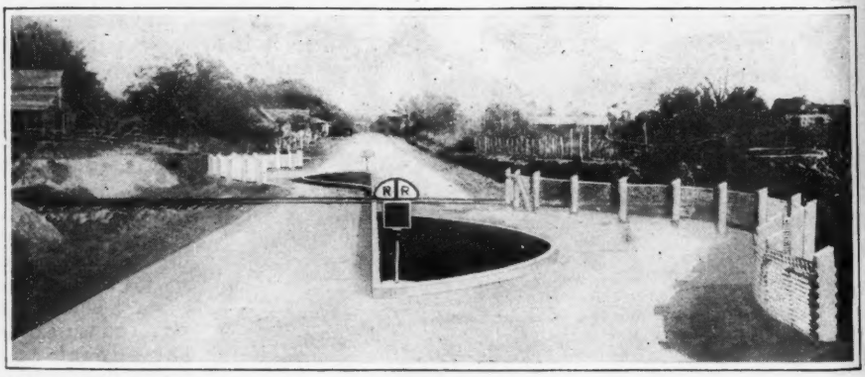
Another unusual feature of this device, invented by Fernando Lopez Cervera, of Mexico City, is that the oars can be folded and turned inside the boat when not in use. They can also be shortened or lengthened by adjusting a bolt in the shell which holds them.

Your old oars can be adapted easily to these attachments. They measure eleven inches in length when folded, and weigh about seven pounds each—light enough to carry. They can be detached from the boat simply by removing a bolt.

Road Garden Slows Up Cars at Grade Crossing

NOTHING could be simpler than the plan pictured below to force motorists to slow down at dangerous grade crossings. Right in the center of the road, on either side of the railroad track, is a half-circle garden. To get around this and through the narrower "neck" of road, the motorist has to watch out and slow down—thus saving himself from danger, whether he is on guard or not.

Heavy highway guards have been placed at this point, too, to prevent possible skidding into the tracks when the surface of the road is wet and slippery.



A new idea to guard motorists at dangerous railroad crossings—a semicircular garden right in the center of the road, forcing autoists to slow up and drive around it

Ties Eraser to Your Typewriter

THIS new device automatically keeps the typist's eraser always in the most convenient place. A tough and durable cord attaches the eraser to a spring-operated reel inside a small metal drum fastened to the typewriter frame. When the eraser is released after use, the reel pulls it back to a position convenient to the right hand. The eraser itself can be of any disk type.

Pocket-Size Balloon Gives Short and Thrilling Rides

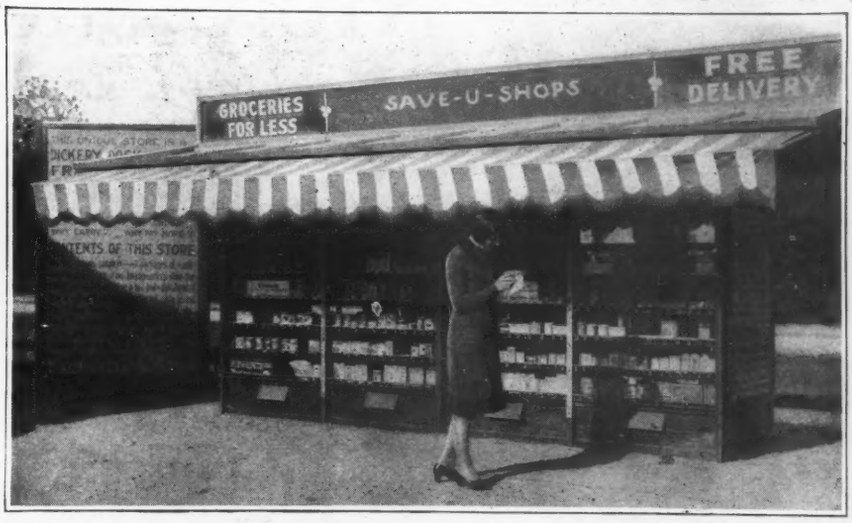
SMALL enough to be fitted into a haversack is the strange balloon invented by Norman Meadowcroft, aircraft engineer, of Hammondsport, N. Y. It weighs only ninety-nine pounds when fully equipped, but gives short air rides.

When filled with gas, the rubberized fabric bag is about twenty-one feet in diameter. The carrying device for the pilot is supported by ropes attached to the bag. A horizontal propeller is mounted so that it may be turned and maneuvered by pulling on the ropes.

The balloon has ascended as high as 840 feet, and has remained in the air for two and a half hours, the inventor says.

As A German mechanical engineer who has been in this country only two years, I wish to say that POPULAR SCIENCE MONTHLY is the best magazine I have ever read, and I hope I shall never be without it.—W. G. E. P., Hudson, N. Y.

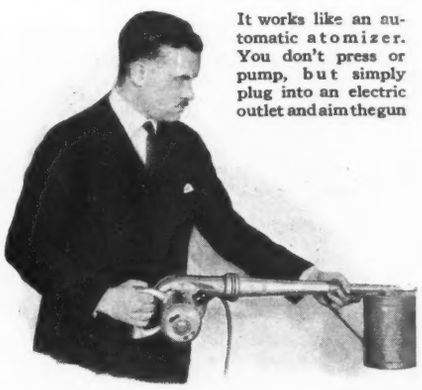
Has Your Town an Automatic Grocery Store?



PRESS a button, and the potatoes and sugar you want are delivered to your door! Her morning marketing is just that easy for the housewife who lives in Inglewood, Calif., where novel automatic grocery stores have been set up on leading street corners.

The shopper looks at the goods displayed in permanent show cases and punches a button underneath what she wants. An order card comes out, she writes her name and address on it and drops it into a slot. The goods are delivered to her home from a central warehouse.

As shown in the photograph, a practically complete line of groceries is offered, for only samples, taking up little space, are displayed.



It works like an automatic atomizer. You don't press or pump, but simply plug into an electric outlet and aim the gun

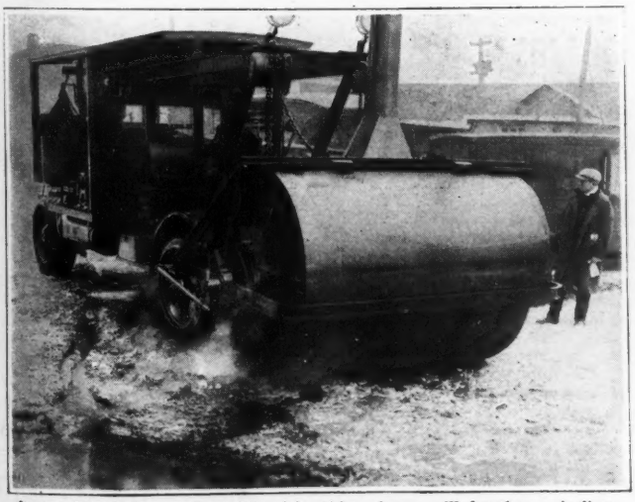
A New Weapon to Fight Bugs

HERE is a new weapon to help you fight insect pests in your home—or factory. It is an electric spraying tank, illustrated at the left. Sufficient force is generated to throw a fine spray of disinfecting liquid a considerable distance, to the ceiling or inaccessible corners.

The disinfecting liquid is contained in a tank, as shown in the picture, and a motor drives the blower. In effect, it is an automatic atomizer. If desired, the tank can be removed and the machine used as a dust blower.

Hot Steel Roller Removes Snow by Melting It

MELTING snow may prove the quickest and most economical way of removing it from city streets. The new "snow converter" shown below, it is said, will remove snow and ice from streets at a cost of 20 cents a cubic yard as compared with $1.65, the present cost.



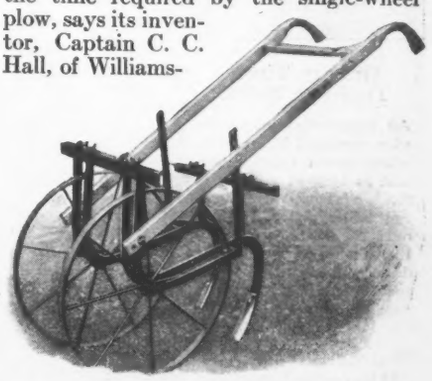
A new sight in some of our big cities this winter will be these sizzling "melters," crawling their way through the streets after a heavy snowstorm

A seven-foot roller of half-inch steel attached to the front of a motor truck is heated internally by oil burners and fueled under pressure from a supply tank mounted on the truck. It maintains a terrific degree of heat. The roller can be raised to melt snow piles and drifts as well as the even fall on the streets.

The roller travels through the streets at a speed of three miles an hour, melting snow as it goes.

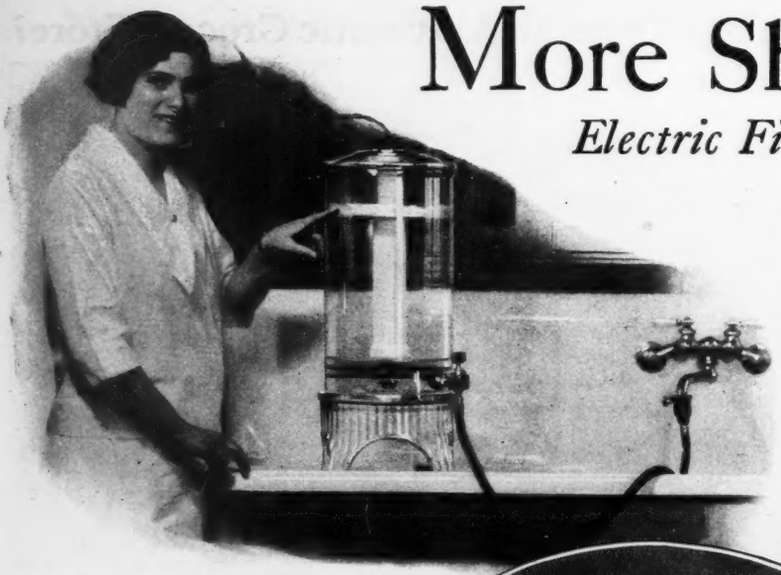
Straddles Plants in Cultivating

ONE trip down a row of onions, beans or corn with this new hand cultivator will complete the cultivation in half the time required by the single-wheel plow, says its inventor, Captain C. C. Hall, of Williamstown, W. Va. It straddles rows of plants of any width up to seventeen inches, and up to eighteen inches high. One of the handles and plow frames can be removed, if desired, leaving a complete single plow. Or the positions of the plow frames can be reversed, making a between-rows cultivator. The plants may be cultivated very close without injury from the wheels.



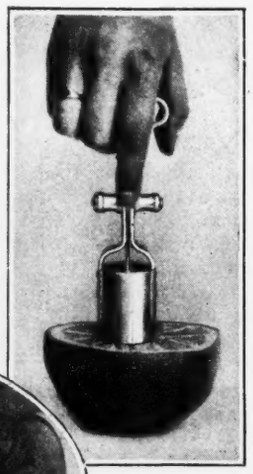
More Short-Cuts *for*

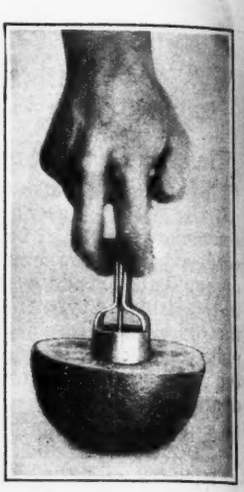
Electric Fixtures That Aren't Fixed,



Purifies Water by Electricity

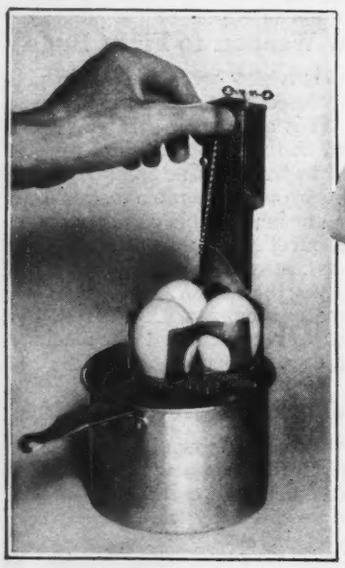
Of all the processes of purifying water—filtration, distillation, boiling, and so on—the newest is the hydroelectric process, illustrated in the household water purifier shown above. This device plugs into your electric circuit, and is said to remove all sewage, trade waste, undesirable tastes and other contamination from your water supply





Grapefruit Corer Saves the Juice

When the knobs of this grapefruit corer are down, a sharp-edged scoop fits in perfect contact with the inner wall of the tube, leaving the full opening. When the knobs are raised, the sharp edge of the scoop crosses the lower inside diameter of the tube, shearing off the bottom of the grapefruit core and pressing out all the juice



Shoe Polish Like a Shaving Stick

A new kind of shoe polish (above) comes in handy stick form like shaving soap, is said to be odorless, and, according to the maker, will not soil your hands. The polish is specially designed to make shoes waterproof and to preserve the leather. Its novel form makes it convenient to carry in the pocket

The "Vac" Now Waves Floors

The vacuum cleaner at the left, if you notice, is not "sweeping" a carpet but polishing a waxed floor. A new polishing attachment, easily adjusted, fits the vacuum cleaner nozzle and is operated by the same motor. Since the secret of fine floors is a little wax frequently applied, this latest accomplishment of the "vac" will be welcomed

Tooth Paste Server Fastens to Wall

Even Johnny won't waste the tooth paste if he can squeeze it out of the server shown above. Turning a key delivers the correct amount of paste. The tube winds around a roller and is compressed between the broad blades. New tubes are inserted easily. The device can be used for shaving cream, too

Gravity Times This Egg Boiler

An automatic timing device, operated by gravity, which keeps eggs boiling just as long as you set it for, is a feature of the novel egg boiler above. It fits over the kettle and pulls the eggs up when they are done. The egg rack is attached to a weight that runs the time mechanism

Warms Baby's Milk Wherever You Go

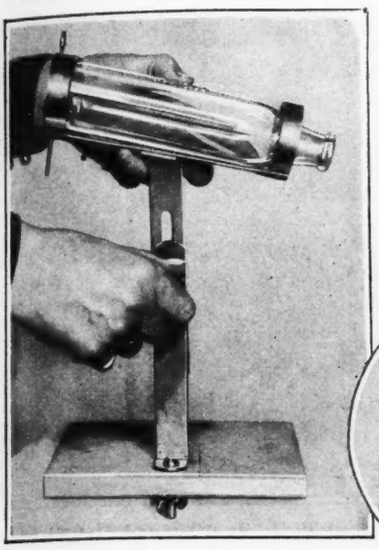
Where gas or electricity isn't available or convenient, warming baby's milk may be accomplished on the specially designed "canned heat" milk warmer shown at the right. The bottle fits in a container and the container is placed over the alcohol flame. It will come in handy when traveling and on picnics

Electric Light Fixtures That Aren't "Fixed"

Plugging-in your electric light fixtures as you would attach a toaster or iron is possible with a new base for fixtures (right). The fixtures can thus be removed for changing the furniture around—or, when you move, you can take your lighting fixtures with you. The electrical connection is made with the standard plug. A special construction behind the outlet in the wall gives firm support to the fixture

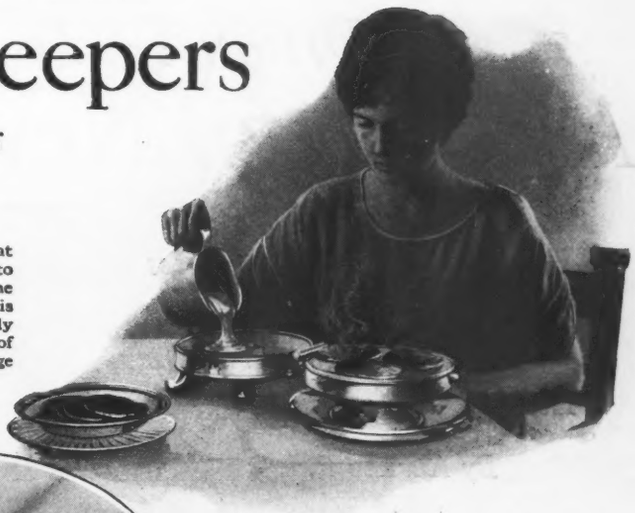
Efficient Housekeepers

New Table Stove and Other Helps



Supports the Bottle in Feeding Baby

The new nursing bottle holder at the left makes it unnecessary to hold the bottle yourself to the baby's mouth every time he is fed. Made of metal, it is easily attached, at any angle, to the tray of a high chair or to a baby carriage

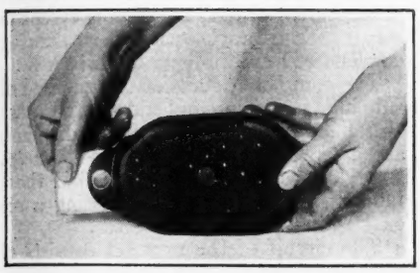


Pancakes or Waffles—Both from One Stove

Waffles today, pancakes tomorrow—both can be made on the same combination electric stove and right at the breakfast table, too. One side of the reversible plates is in waffle iron form, the other side smooth, as shown above. Or the plates can be removed entirely, leaving hot plates to use for frying eggs or cooking coffee

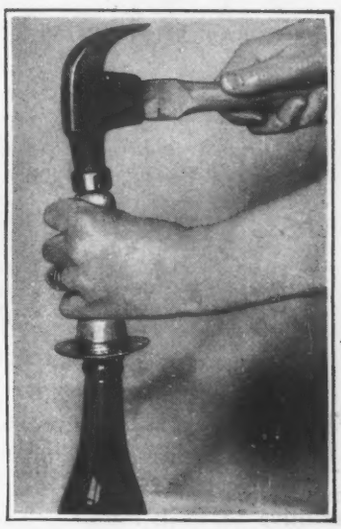
Rubber Holder Saves the Soap

A saver of soap is the rubber bath sponge below, which holds either a whole cake of soap or small pieces. The sponge is fastened shut by slipping a bone button through slots in its rubber tips. It is good for massaging, too, the soap oozing out through perforations



Squeezing the Handle Sifts the Flour

Squeezing the handle of the one-handed flour sifter above agitates the screen within and sifts the flour, making it possible to stir batter in the mixing bowl with the other hand



Guards Hand in Bottling

In case the bottle breaks while you are bottling catsup or grape juice, this capper, above, protects your hand. The protector is the circular metal piece above the cap

Tea Ball That Works Like Scissors

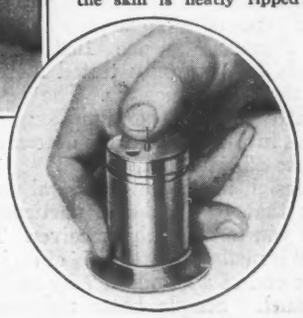
You can make a cup of tea more quickly with the scissors-like tea ball shown at the right. It springs shut, and having a long handle, can be stirred about in the pot until the tea is the right strength. It holds enough tea for several cups

Cloth Jelly Strainer Fits on Any Kettle

In jelly making season, this straining outfit (left) prevents many a scald and helps in making clear jellies. Two straining cloths fit in a metal rame, one inside the other. These may be washed easily. The frame is adjustable so that it may fit on the rim of any ordinary size of kettle, and collapses so that it takes up very little room in the cupboard

Hooked Blade Peels Oranges

We'll all eat more oranges, now that a peeler has been invented (left) to make the job of skinning them less messy. The orange is scored around, a little hook on the end of the blade is inserted, and the skin is neatly ripped down



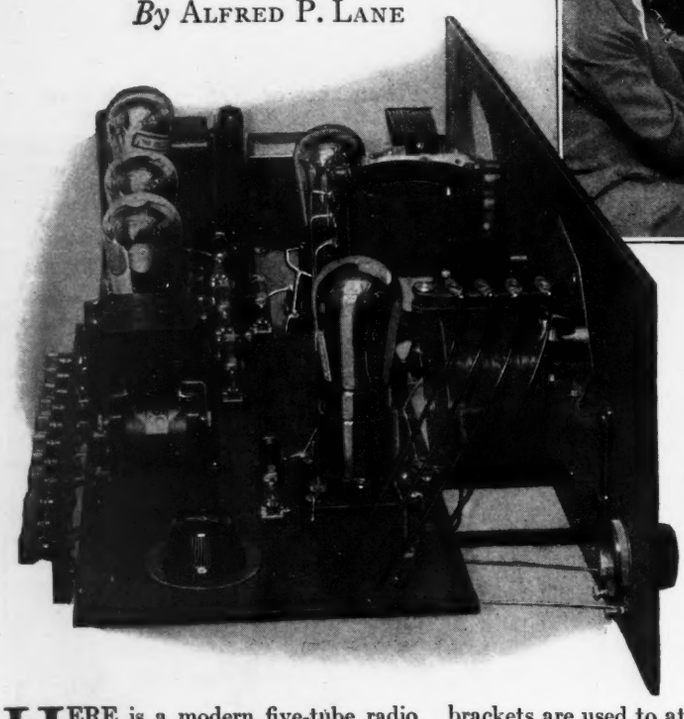
Press the Top—Out Comes a Pin

Press the top of the box at the right, and out comes a pin—head first, too. It is a convenient accessory for the dressing table, as well as for the sewing room or the office desk. Picking up a pin from a dozen others in a tray often pricks the finger, and extracting them from a paper of pins is tedious. This ingenious box offers a new solution

Distance—Tone—Volume—in A *Powerful* New Five-Tube Set

Easily Built Receiver Uses the Latest Types of Audio Tubes with Remarkable Economy—How to Make It

By ALFRED P. LANE



Tested and Approved by the Institute of Standards

This model five-tube receiver passed the tests of the Popular Science Institute of Standards with a very high rating. During the actual working test in the Radio Laboratory, the receiver drew only 15 milliamperes of current from the B-battery when used with the new 171 type power tube, or 8 mils when tubes such as the UX112 or Mu6 were placed in the last socket. You get maximum life from B-batteries with this receiver

You Can Build It Easily

Fig 1. A standard type of cabinet, standard panels and plain brass brackets form the framework, and the arrangement allows plenty of room for any standard parts approved by the Institute

HERE is a modern five-tube radio receiver, easily built, that combines to the highest degree the qualities you want most. It is remarkably sensitive to weak signals. Tuning is almost knifelike in sharpness—as sharp, in fact, as is possible without causing distortion. The volume is tremendous, and the quality of the reproduction is practically perfect. All musical notes, from the lowest to the highest, come out of the loudspeaker with clear, lifelike fidelity.

Combined with these advantages is another feature of great importance to the radio fan who does not possess a B-battery eliminator. This new POPULAR SCIENCE five-tube receiver is extraordinarily economical of B-battery current even when used with the latest and most powerful types of audio amplifying tubes.

The Popular Science Institute of Standards has carefully tested and approved the model receiver. The figures for B-battery current consumption given elsewhere in this article were determined during the official tests.

The design incorporates several novel features that will make it particularly easy for you to build this receiver. The subpanel is made by cutting ⅝ of an inch from the end of a standard 7 by 24 inch front panel. Simple brass right-angle brackets are used to attach the subpanel to the front panel, and the weight of the subpanel plus the instruments mounted on it is supported at the ends by wooden strips nailed to the inside of the cabinet and by the binding post panel at the back. And should you prefer to use a wooden baseboard instead of a composition subpanel, no change need be made in the arrangement of the instruments except to make special brackets for the balancing condenser *H* and inductance switch *W*.

The complete details of this method of subpanel mounting and support, together with a large-sized picture wiring diagram, are given in blueprints Nos. 54 and 55, listed on page 92. You will find these blueprints a great help in building a set exactly like the model receiver.

The circuit of the new set consists of one stage of radio-frequency amplification, a regenerative detector, and a stage of transformer-coupled audio-frequency amplification followed by two stages of resistance-coupled audio amplification. It is arranged for the use of any of the latest types of power tubes in the last audio amplifying stage, and a choke and by-pass are included to improve the quality by preventing any flow of direct current through the loudspeaker. This eliminates any chance of demagnetizing the loudspeaker or burning out the windings.

NO INTERSTAGE jacks are included in the circuit because best results always are obtained by operating the loudspeaker on the power tube in the last stage with the volume regulated to suit by rheostat *T*.

All five tubes are controlled by self-adjusting rheostats with a hand operated rheostat in series with the self-adjusting rheostat connected to the radio-frequency amplifier tube. By turning this rheostat *T* you can cut the broadcast music or speech from full volume down to complete silence without affecting the quality. Incidentally, this method of filament control makes it possible for any member of the family to operate the receiver, since there is no possibility of damaging the tubes by burning them too brightly.

Ask Us!

SEND for the list of radio apparatus approved by the Popular Science Institute of Standards. It will help you to choose parts that will enable you to build a satisfactory radio receiver.

Remember, also, that blueprints Nos. 54 and 55 listed on page 92 will prove a great help.

We want you to make a success of building this powerful new set. If any points do not seem clear or you want any special information about the proper parts to use, we will be glad to answer all questions without charge. Please make your letters as detailed and specific as possible and address them: Radio Editor, Popular Science Monthly, 250 Fourth Avenue, New York City.

The receiver is designed for use with an outdoor antenna of from thirty to 150 feet, and it will give excellent results with a short indoor antenna. The tapped antenna coil and inductance switch *W* will make it possible to adjust the set for the best possible combination of distance-getting ability with selectivity depending on local radio reception conditions and the length of the antenna. Here are the parts you will need for the construction of the receiver:

A and *B*—radio-frequency tuning unit.
C, *D* and *E*—detector tuning unit.
F—radio-frequency choke coil.
G1 and *G2*—variable condensers, .0005 mfd.
H—midget variable balancing condenser.
J1—grid condenser .00025 mfd. with clips for grid leak.
J2—tickler by-pass condenser .0005 mfd.
J3—C-battery by-pass condenser .01 mfd.
J4—audio by-pass condenser 2 to 4 mfd.
K—audio transformer.
L—audio-frequency blocking choke.
M1, *M2*, *M3*, *M4* and *M5*—vacuum tube sockets.
N1 and *N2*—resistance-coupling mountings.
R1—grid leak 2 to 8 megohms.
R2, *R3*, *R4* and *R5*—coupling and leak resistances .1 megohm (100,000 ohms).
S1, *S2*, *S3* and *S4*—self-adjusting rheostats size 1A.
S5—self-adjusting rheostat size 112.
T—25-ohm rheostat.
U—open circuit jack.
V—filament switch.
W—inductance switch.
X1 and *X2*—standard composition panels 7 by 24 by 3/16 inches.
Y—binding post panel 1¼ by 12 inches.

Eleven binding posts, two vernier dials, two knobs, strip brass ⅛ by ⅜ inches, bus wire, spaghetti, screws and nuts.

All of the parts used in the receiver are of standard construction and can be obtained from any dealer in radio supplies. The design of the set allows plenty of room for parts of almost any make on the market.

Most radio fans will prefer to buy the tuning units *A*, *B* and *C*, *D*, *E* already wound and mounted; but for the benefit of those radio fans who wish to wind their own coils, here are the specifications. Coil *A* is wound with 15 turns of No. 24 single silk-covered wire tapped at the fourth and eighth turns. Coil *B* has 50 turns of No. 22 single silk-covered wire wound spaced so that there are twenty-nine turns to the inch. You can get this spacing by winding a piece of No. 8 cotton thread in the coil as a spacer. Coil *C* is wound with twenty-four turns of No. 26 single silk-covered wire wound without spacing and tapped at the center. Coil *D* is just like *B*, while tickler coil *E* is wound with thirty turns of No. 24 single silk-covered wire wound without spacing.

Coils *B* and *D* are 3 inches in diameter. Coils *A* and *C* are 2¾ inches in diameter. Coil *E* is 1½ inches in diameter.

Several types of radio-frequency choke coils are now on the market that are suitable for use at *F*. You can wind this choke coil yourself if you prefer. Wind about 600 turns of No. 32 cotton or silk insulated wire on an ordinary thread spool. Do not wind the wire in smooth layers. It should be jumble-wound or, in other words, criss-crossed back and forth.

THE variable condensers *G1* and *G2* are of the modern straight-line frequency type.

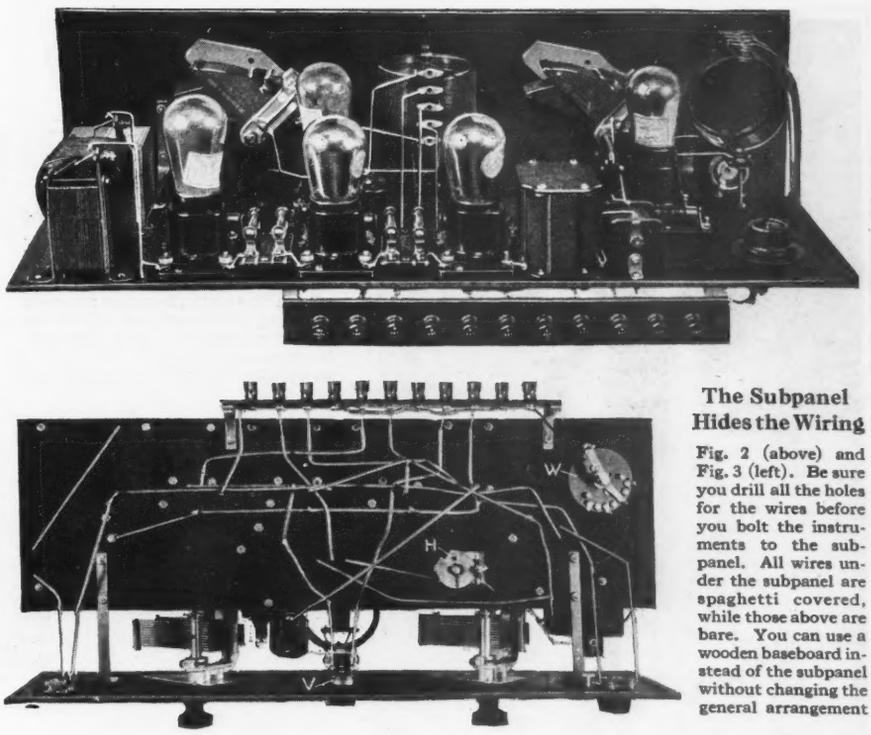
Use a high grade audio transformer at *K*. The quality of the reproduction depends on a high grade transformer at this point in the circuit.

Several styles of choke coils suitable for use at *L* are now on the market.

The audio by-pass condenser *J4* should be not less than 2 mfd. for best quality. A 4 mfd. condenser was used in the model receiver so that there would be no doubt on this point. *N1* and *N2*, the resistance-coupling mountings, are of standard type, consisting of a coupling condenser and clips for mounting the coupling resistance and leaks *R2*, *R3*, *R4* and *R5*.

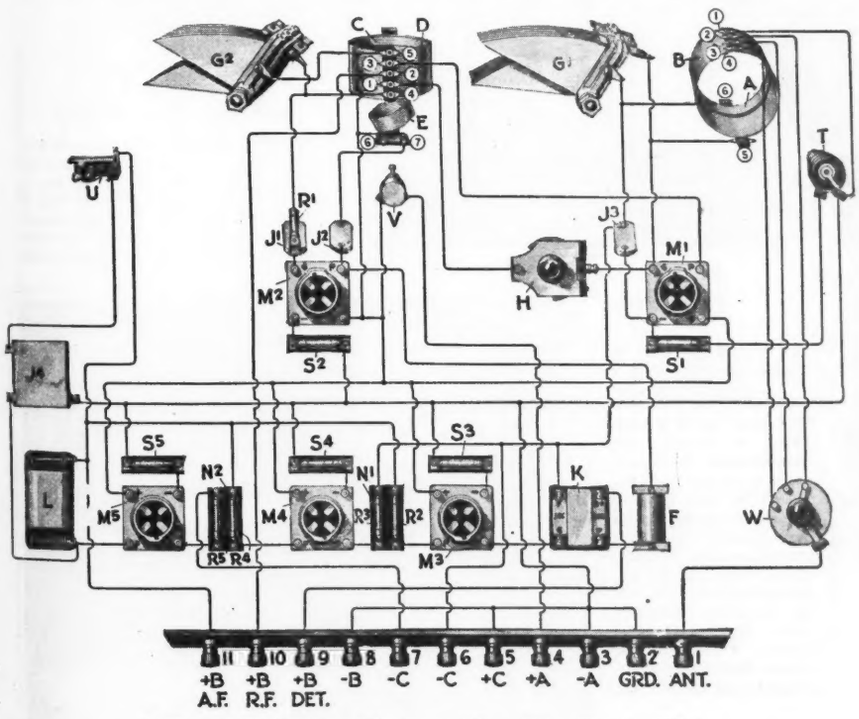
Your dealer will be glad to help select parts suitable for use in building this receiver. You will save time if you take a copy of the magazine along with you.

Many radio fans live where the buying of radio parts is not a simple matter, and if you have diffi- (*Continued on page 152*)



The Subpanel Hides the Wiring

Fig. 2 (above) and Fig. 3 (left). Be sure you drill all the holes for the wires before you bolt the instruments to the subpanel. All wires under the subpanel are spaghetti covered, while those above are bare. You can use a wooden baseboard instead of the subpanel without changing the general arrangement



Follow This Picture Diagram When You Do the Wiring

Fig. 4. When the picture wiring diagram shows one wire connecting to another, you are to make the connection to the nearest point on the wire. Make every connection as short as possible

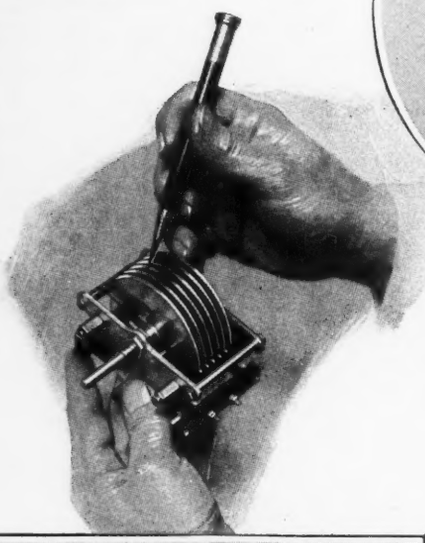
Radio Novelties *on* Land *and* Sea

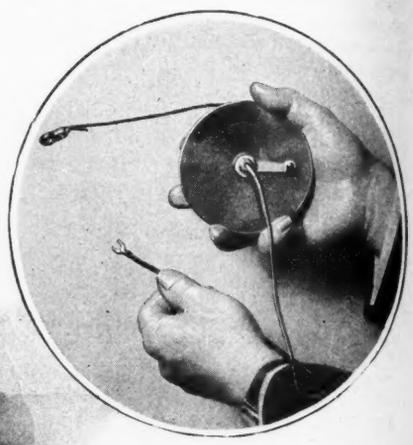
Portable Antenna Takes Parasol Form

Twelve metal loops are set into a metal bracket mounted on the end of a wooden pole, in the queer antenna above. Each loop of wire is kinked to increase the actual amount of wire in each loop. This new antenna is said to be remarkably efficient

Condenser with Novel Plates

At first glance this new condenser, below, looks just like the older models built to give straight-line capacity effects. The plates, however, are made of heavy cast aluminum tapered so that the capacity of the condenser increases rapidly to give the desired straight-line frequency tuning effect



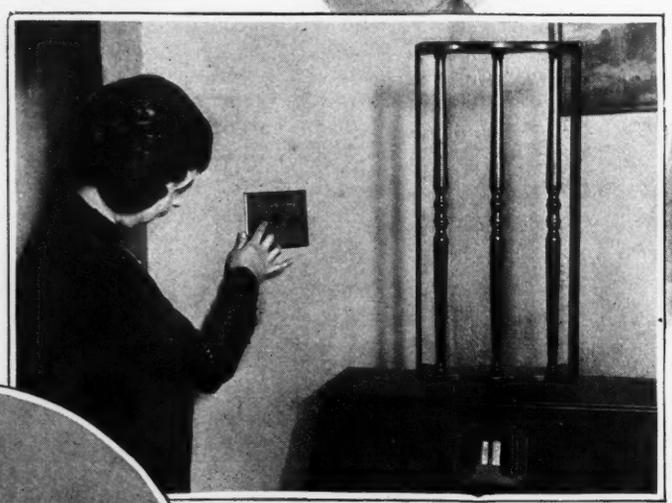


This Antenna Reels Up

For use with portable radio receivers or as an antenna wherever it is not possible to put up a permanent installation, this reel antenna, above, will prove useful. It consists of a copper strip that winds around a drum inside a metal case. A plug makes the connection to the set

Why Not Wire Your House for Radio, Too?

A house recently built on Staten Island, N. Y., was wired for radio as well as for electric lights. Wall switches in every room permit the switching of programs from room to room or to have every loudspeaker in the house going at once. One master set is connected to the wiring, and there are additional sets in several rooms



Vacuum Tube Muffled

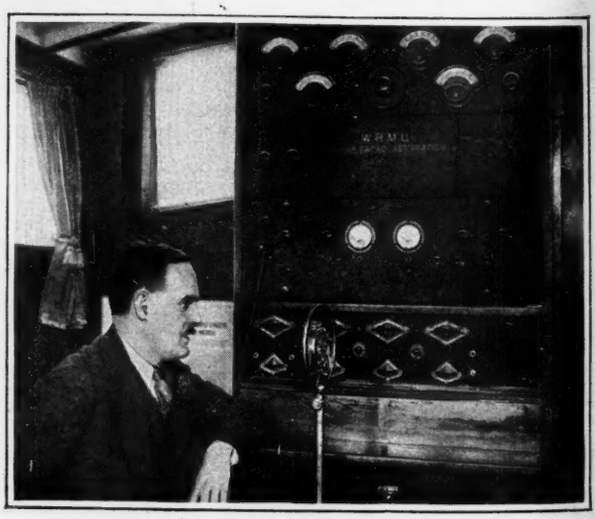
Instead of the usual solid composition base ordinarily found on modern vacuum tubes, the one above has a base divided into two sections with a rubber pad between, and the prongs are connected by light wire. It eliminates ringing and audio feedback noises

This Tube Is Almost a Complete Set

David L. Loewe, of Berlin, has arrived in this country with a marvelous new radio tube (above) performing three functions at once. It is at once a detector, a stage of audio and a stage of power amplification. Adding a tuning coil completes the set

New Radio Ship Goes on the Air —and Water

The new cabin cruiser MU-1 is fitted with broadcasting equipment of the most modern type. It will be used to relay reports of marine sporting events on short waves to station WAHG, where they will be retransmitted on a wave in the standard broadcast band. Right: Douglas Rigney, owner of the cruiser, before the microphone of the transmitter



How to Cut Floor Maintenance Costs

BEAUTIFUL floors, so essential to a pleasing interior, now are easily had through the Johnson Wax treatment. Quickly, inexpensively, with no hard work, this cleans, sanitates and polishes at one easy operation. It is ideal for *every* floor!

Wood, linoleum, tile, marble or composition floors—whether varnished, shellacked, waxed or painted—are lightly filmed with Johnson's Wax. Then the Electric Polisher is guided over them. You will be amazed at the wonderful improvement—and at the speed of it! Like magic this Electric Floor Polisher creates a gleaming, deep-burnished lustre which glorifies, protects and preserves the original finish.

Floors thus treated impart to rooms that coveted aspect of immaculate, well-kept beauty.

JOHNSON'S POLISHING WAX

PASTE *or* LIQUID ~ CLEANS. POLISHES. PRESERVES ALL FLOORS

for
OFFICES
CLUBS
HOMES
APARTMENTS
HOSPITALS
INSTITUTIONS
HOTELS
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Neighborhood stores, or your painter, can rent you a Johnson Electric Floor Polisher for $2.00 a day. With it floors and linoleum are wax-polished in a tenth the time hand-work can do it. And the electrically-produced polish is far more bright, uniform and brilliant. Operating a Johnson Electric Floor Polisher requires no skill, experience or effort.

For $2.00 a day you can rent a Johnson Electric Floor Polisher from your Neighborhood Store or from your Painter. Telephone NOW and make an appointment to rent this labor-saving machine for a day. Or, purchase one outright for your own exclusive use. The investment is small for so great a convenience. Your local merchant can supply you—or we will send one express prepaid.

For the most complete, up-to-date information on the care of all floors, old or new, consult our book *"The Proper Treatment for Floors."* It will save you much money and endless difficulties. Mail the attached coupon, properly filled out, and you shall have a copy FREE. Send for it today—whether your floor areas are large or small.

FREE—25¢ Book on FLOORS

I am interested in Floor Finishing and Floor Maintenance. Please send me Free and Postpaid your new 25c Book *"The Proper Treatment for Floors."*

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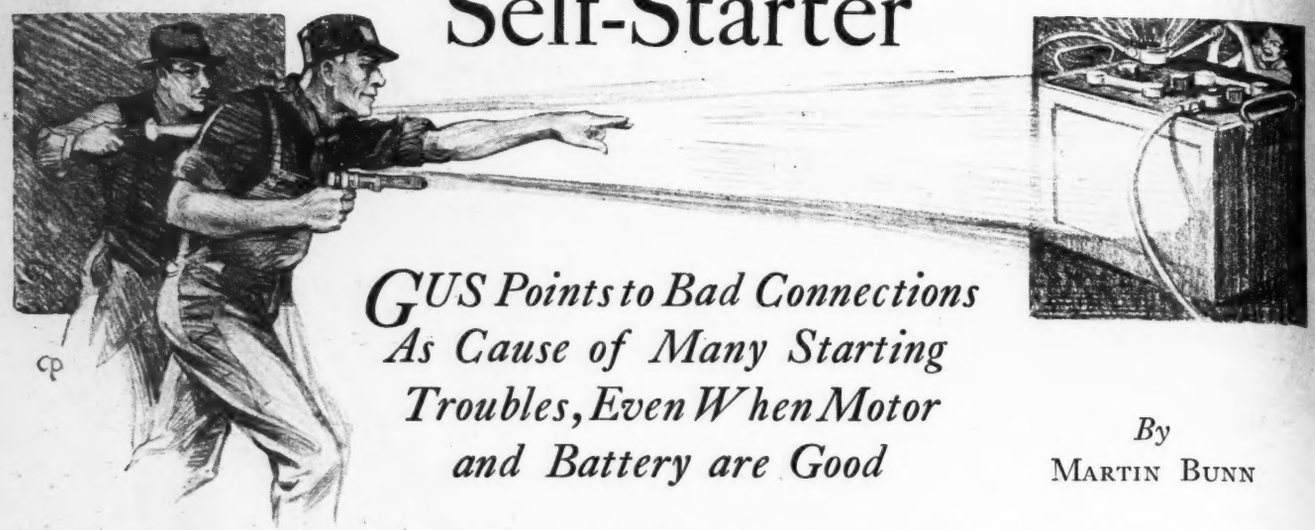
[Canadian Factory:—BRANTFORD]

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Don't *Be* Too Quick *to* Blame *Your* Self-Starter



GUS Points to Bad Connections As Cause of Many Starting Troubles, Even When Motor and Battery are Good

By MARTIN BUNN

"IT'S funny how we seem to have runs first on one kind of work and then on another," observed Joe Clark to Gus Wilson as the two partners prepared to close the Model Garage for the night.

"Right now it seems to be all electrical troubles," agreed Gus.

"Here's another one, I'll bet two cents!" Joe muttered under his breath as a shiny, new car pulled up in front.

The driver of the car looked as though he had been doing strenuous work.

"The self-starter is on the blink. Can you fix it?" he called out. "I had to crank it by hand to get down here. I can't see why it should go bad all of a sudden. It worked fine up to now."

Gus didn't ask any questions. He climbed in behind the wheel and, after testing the lights and noting that they seemed to be working at full brilliance, stepped on the self-starter pedal. There was a clank as the starter motor gear engaged with the teeth on the engine flywheel. The lights immediately went out, but the starter motor appeared to be too weak to spin the engine. Gus took his foot off the self-starter pedal, and the lights at once returned to full power.

"Humph!" he grunted. "I don't think there is anything the matter with the self-starter. The trouble probably is in the battery connections.

"That's it, all right," he continued, after he had pulled up the floor boards and examined the clamps on the battery terminal lugs. "Look here! This one is loose."

It was so loose, in fact, that he was able to pull it off without touching a wrench to the clamping bolt. Joe handed him a piece of sandpaper, and Gus proceeded to give both the battery terminal and the clamp on the end of the cable a good polishing.

After he had bolted it firmly back in place, he removed the other terminal and gave it the same treatment. "And while we are about it," he observed, "I'm going to inspect the battery to make sure that it's getting enough charging."

When Gus had put the floor boards back in place, Burns, the owner of the car, stepped on the starter pedal, and the starting motor spun the engine at a great rate.

"Gosh, that's fine!" exclaimed Burns. "It's simple enough when you know how, I suppose. Still, I don't see why the lights should work when the self-starter was dead as a doornail. I always thought that electric current either flowed if there was a circuit or didn't flow at all if the circuit was broken. I didn't know there were half-way points."

"That idea," Gus explained, "is responsible for a whole lot of electrical trouble on automobiles. Electric current going through a wire is a whole lot like water flowing through a pipe. It's a matter of pressure and volume. In the spark plug circuit you have thousands of volts pressure to shove a small volume of current through the resistance of a poor contact. Conditions in the starter motor circuit are just the other way around. The storage battery only develops a pressure of six volts, and yet you have to push as much as two hundred amperes through the windings of the starter motor to get power enough to start the engine when it is cold and stiff."

BURNS was interested. "I had no idea that the self-starter took so much current. That explains why they put in such a big cable to connect up the battery with the starter switch and motor."

"Right," Gus replied. "The big cable is absolutely necessary.

"Even when all the connections and the switch are in good condition, there is still a chance for trouble. If the brushes that make contact with the commutator of the starter motor get burned a bit, the extra resistance will cut down the current enough to make the self-starter sluggish and irregular.

"The queerest trouble I ever ran into," Gus continued, "wasn't due to anything wrong with the wiring or the brushes, although this self-starter certainly acted as though there was a poor connection somewhere. One time it would spin the motor just as it ought to, and the next time it would fail to work at all. I went over all the connections, cleaned the switch and sandpapered the starter motor brushes. But it didn't help matters enough to notice.

"I finally located the trouble under the frame of the self-starter motor. You know the current goes back to the battery by way of the frame of the car, and bolts holding the self-starter motor in place had worked loose. The car had been at the seashore for quite a while, and the dampness had caused rust. Some sandpaper cured the trouble."

"But why didn't the current get to the frame through the self-starter pinion and the gear on the flywheel?" asked Burns.

"Part of it must have gone that way," Gus replied. "But there isn't much chance for a lot of current to flow through the oily bearings of the crankshaft or the fabric facings of the clutch plates."

"And I suppose it couldn't get to the flywheel gear anyway on account of the oil on the pinion and gear," added Burns.

"You're wrong there," laughed Gus. "The bendix type of starter gearing that is used on so many cars now is a peculiar piece of mechanism. It's the one moving part of the car that works better without oil. Don't ever oil it.

"A MAN who lives down the street here wouldn't believe me when I told him that, and he smeared a lot of cup grease all over the self-starter. It worked all right for a while, and then one chilly morning he stepped on the pedal and the starter motor hummed at a great rate without engaging with the flywheel. He tried again, and the engine started. Then it wouldn't disengage, and the strain busted three teeth out of the flywheel gear. He believes me now!"

"Light oil wouldn't gum up like that when it got cold," suggested Burns. "Why not use that?"

"Don't do it," Gus insisted. "Even light oil is bad because it picks up dust and dirt, and after awhile the starter gets all gummed up."

"Well, it's a relief to know that there's at least one part on the car that will work best if I neglect it!" laughed Burns as he stepped on the self-starter.

Great Broadcasting Stations* listen to their own programs with DAY-FAN

RADIO RECEIVERS

YES, the radio broadcasting stations listen to their own programs, and with a receiving set, just as you do. Else how could they judge the clearness and tone quality of their speech and music? The radio they use has to be of magnificent tone, to do justice to their studio performance: it has to be the last word in selectivity to tune out a station in the same building, and bring in others for comparison from far away.

Significant thing that so many of the great broadcasting stations, who certainly know more about radio than anyone else, have selected the Day-Fan Radio Receiver for their listening rooms!

This is the final stamp of approval for Day-Fan, which was the first to perfect single dial control, the first to receive all stations at their newspaper numbers, the first to publish its own Air Telephone Directory, and which now covers your every need with five, six, and seven-tube sets from $89.00 to $250.00.

The radio receiver of the broadcasting stations is the radio receiver for your home. Send us your name and address for booklet and address of nearest dealer.

© D. F. E. CO. 1926

Day-Fan in the Broadcasting Station Listening Room, where tone quality is tested.

* *Among the great Broadcasting Stations who authorize us to say that they use Day-Fan Receivers in their listening rooms to test tone quality and clearness of reception are—*

WMCA, New York (Hotel McAlpin); WEBJ, New York (Third Avenue Railway System); WQJ, Chicago (Calumet Baking Powder Co. & Rainbo Gardens); WLIB, Chicago (Liberty Magazine); WNAC, Boston (The Shepard Stores); WTAM, Cleveland (Willard Storage Battery Co.); WCAE, Pittsburgh (Kaufman & Baer Co.); WCCO, Minneapolis and St. Paul (Gold Medal Radio Station, Washburn-Crosby Co.); KFNF, Shenandoah, Ia. (Henry Field Seed Co.); WOWO, Ft. Wayne, Ind. (Main Auto Supply Co.); WOAW, Omaha, Neb. (Woodmen of the World Life Insurance Co.); WAAW, Omaha, Neb. (Omaha Grain Exchange); WEAN, Providence (The Shepard Co.); WCAL, Northfield, Minn. (St. Olaf College); KWSC, Pullman, Wash. (State College of Washington); WCBD, Zion, Ill. (Zion Broadcasting Station).

Do Away With Local Interference

No, not all the noise in your radio is caused by static. Most of it is local, caused by your own small household appliance motors through the house wires. These noises go direct to your set, spoil your entertainment, and get blamed as "static".

Quietus, which has nothing to do with the set itself, is a Day-Fan accessory which stops these noises before they reach your set.

Improve the clarity of your reception—write us for information on Quietus.

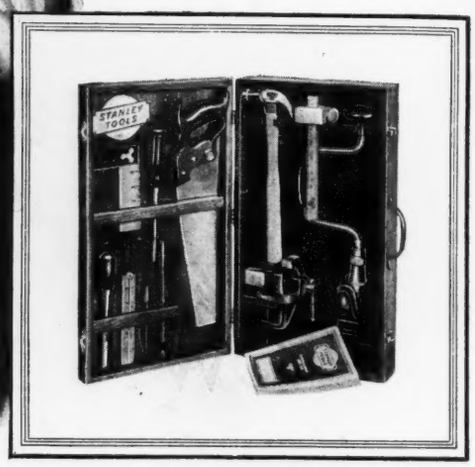
Model 6001, illustrated, is for general purposes—oil-burner pump, electric refrigerator, etc. Price $10.00. We also have Model 6003 for home lighting plants. Price $8.00.

Day-Fan Electric Co., Dayton, Ohio. Dept. P. S. 1. You may send me information regarding Day-Fan Radio and address of nearest dealer.

*Name*_____ *Address*_____ *State*_____

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Buy separately or in assortments



She will approve a hanging bookrack

AN open bookrack that hangs on the wall is fashionable just now. Why not make one yourself? There's real satisfaction in making something with your own hands. Relaxation, too. With a set of Stanley Tools you are able to attend to odd repair jobs and make many of the things you want around your home.

Good tools are necessary to do really good work. Every Stanley Tool is as efficient as expert craftsmanship can make it. That's why nearly every carpenter uses Stanley Tools. And that is why they are the first choice in thousands of manual training classes.

You can buy Stanley Tools separately and gradually accumulate your own set. And there are sets of Stanley Tools in a wide range from which to choose—from No. 904 containing 12 tools in a sturdy oak chest at $15, to No. 850 containing 49 tools in a beautiful cabinet at $95.

There are also assortments of the same Stanley Tools in strong cardboard boxes with careful directions in each from which you can make your own chest. Prices $5 to $20.

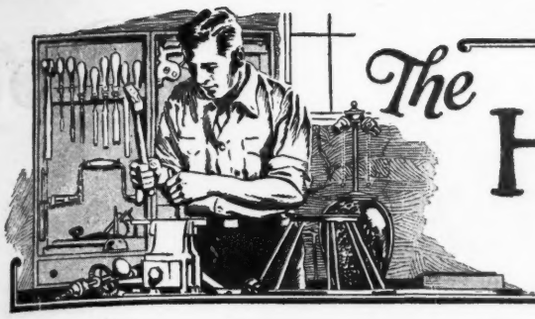
IMPORTANT: For only 10c (to cover cost of printing and mailing) we will gladly send you a plan sheet which gives full directions for making a bookrack like the one shown above. Ask for Plan No. 1—PS.

Ask your hardware dealer to show you the line of Stanley Tools. And send for our Catalogue No. 34 which describes Stanley Tools both separately and in assortments. Address: The Stanley Works, New Britain, Conn.

The best tools are the cheapest to use
Ask your hardware dealer

STANLEY TOOLS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS



The Home Workshop

Arthur Wakeling, *Editor*

A Beautiful Clipper Ship for You

How to Build a Greatly Simplified Model of the Famous "Sovereign of the Seas"

By Capt. E. Armitage McCann

THAT the majority of those who desire to make a ship model should prefer a clipper, is entirely understandable. It is the most beautiful of all ships.

The extreme clipper ships were America's very own. They were first, and best, made here. They swiftly carried America's flag and commerce to the far parts of the earth and made many of the early fortunes upon which the prosperity of this country is established.

Although evolved entirely for utilitarian purposes, to combine speed with carrying capacity, they had a dignified grace not elsewhere found. Every line of their hulls was a graceful curve; their spars and rigging formed a delicate and beautiful tracery. Taken together, these elements combine to make a carefully built clipper ship model an unsurpassable decoration.

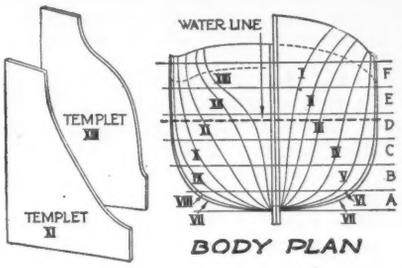
The writer has long hesitated in giving instructions to the uninitiated for the making of such a model because, being familiar with that type of ship, he is well aware of the almost infinity of careful work which can, and should, be put into an accurate and complete scale model.

The demand, however, has been so insistent that he has worked out an easy system by which, in hours instead of months, an accurate hull may be fashioned. He has simplified the fittings and rigging as far as he dared. Though much has been omitted, what is retained is reasonably correct and to scale. The result of following the instructions and drawings should be a model very much better than the great majority one sees.

Sovereign of the Seas

The *Sovereign of the Seas* has been chosen, as one of Donald McKay's finest and fastest clipper ships. She was launched in June, 1852, and was the largest merchant vessel then afloat. Her tonnage was 2421 tons, deck length 258 ft.; she carried 12,000 sq. ft. of canvas, and had a crew of 105 men and boys.

On her first voyage to San Francisco she was dismasted, but made the passage in 103 days. On *(Continued on page 80)*



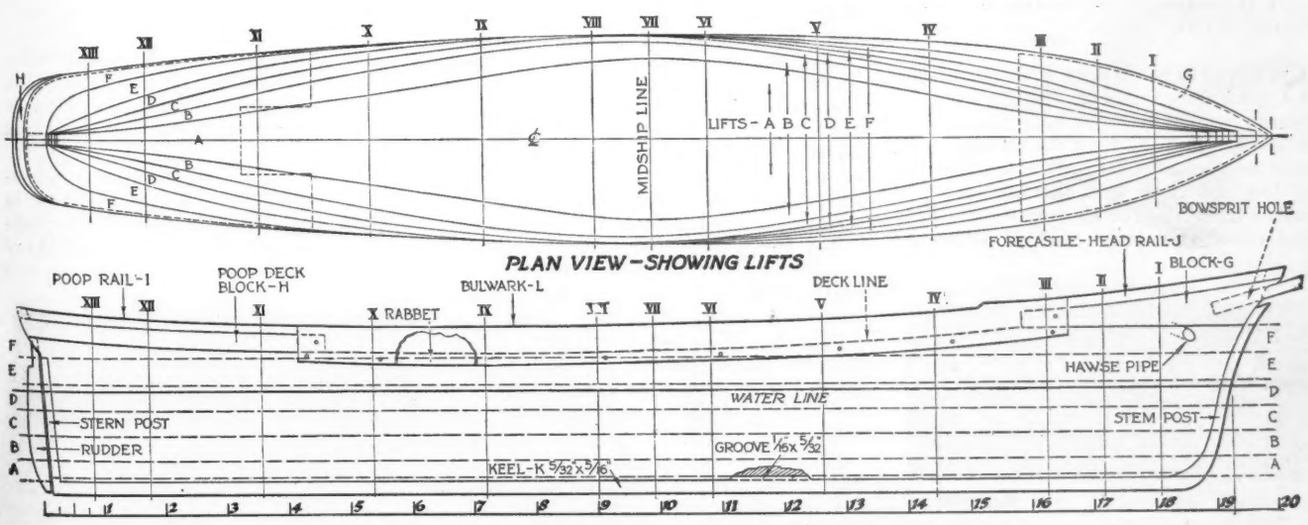


Fig. 1. The hull of the model exactly one-third full size. A complete set of full-size drawings—hull, rigging and details—can be obtained by sending 75 cents to the Blueprint Service Department of Popular Science Monthly for Blueprints Nos. 51, 52 and 53. **(See page 92)**

Stenciling Is Easy to Do

How to Enrich the Appearance of Painted Walls with Borders of Beauty and Distinction

By Berton Elliot

Painting and Decorating Expert

MRS. McAllister and Mrs. Andrews were standing on the porch after the regular meeting of the neighborhood ladies' card club, when I arrived home early one midsummer afternoon.

"Good evening!" said Mrs. McAllister. "We're glad you came. We want you to tell us just how you did those stenciled borders."

"Yes!" chirped Mrs. Andrews, "ever since you showed us your stippled wall decoration, we have wanted to know more about stenciling and the use of stencils."

"Well, ladies," I replied, "if you have a half hour to spare, I'll tell you about it.

"Stenciling is really very simple. In fact, you'd be surprised how simple it is. To anyone who has never done this work, it is inconceivable that anything which adds so much to the appearance of a room can be accomplished so simply.

"I've got one of the stencils right here (Fig. 2). You see there's a guide hole at each end—or in other words the little cut-outs at the extreme ends of the pattern are exact duplicates. When one section of the design has been stenciled on the wall, the stencil is moved along so that the guide hole at the left end of stencil fits right over the stenciled spot on the wall at the extreme right of the pattern. The stencil is moved along length after length and always joins perfectly."

I went on to explain and demonstrate the method in detail. The substance of what I said was as follows:

All of one color is done around the room. Then, on a two-color design, the other part of the stencil is used, and the second color put in clear around the room. There are guide holes on the second color part of the stencil which fit over certain parts of the first color part of the border on the wall. Some stencils are in more than two colors, and the same principle is used in getting the correct register of pattern and colors.

STENCILING is done with a brush like that shown in Fig. 2. The stencil is placed against the wall, care being taken to have it parallel with the ceiling. This may be regulated by cutting off the top of the stencil so that the top edge will follow the ceiling or the picture molding and allow the design to fall whatever distance is desired from the ceiling.

In some instances, as in bathroom or kitchen, the stencil is placed just above the wainscoting or chair rail, in which case the bottom of the stencil would have to be trimmed to be parallel with the guide-line it must follow.

The brush is dipped into the color, a little of which has been poured onto a plate, and then is pounced onto the wall with a rotary motion. As in Fig. 1, the brush is held at right angles to the wall.

Fig. 1. Mr. Elliot demonstrates the application of a border stencil. Another color will be added to the design by means of a second stencil applied like the first one

Either opaque or transparent colors may be used. The soft tinted effects are better accomplished with the transparent material, while the opaque materials must be used where the border design is to be lighter than the background. Otherwise, it is largely a matter of individual preference and the particular effect desired.

Regular stencil colors are sold in tubes by most stores, these generally being of the transparent type (easily changed to opaque by the addition of flat wall paint). Regular flat wall paint in colors, or in white tinted with oil colors to the desired shade, are often used where opaque material is desired.

For thinning stencil colors to the desired consistency, turpentine may be used, but the "glazing liquid" which is used for glazed or stippled (Tiffany) effects, is preferable. When used, it will be found that the paint does not pile up so much on the stencil, and also that the color will dry with a slight sheen, which is very pleasing.

Do not, however, have the color too thin so it will run under the stencil, and always apply it with scant brushfuls. Another thing that must be done is to wipe the side that goes against the wall after each setting, so that any color which gets over on the back of the stencil will not smudge the wall at the next setting. The stencil should be laid face down on a piece of paper and wiped off with a cloth, preferably moistened with gasoline or turpentine. Care is necessary or the cloth may catch and tear the stencil.

A FEW thumb tacks may be used to hold the stencil in place, if desired, especially until one becomes accustomed to using it. They will not injure the wall in the least if put in lightly and carefully withdrawn.

The stenciling should be started in the least conspicuous corner, and kept on around the room. With most stencil designs, the stencil may be bent to fit into the corners, always being careful not to break any of the delicate cut-out work. Some leave the corners until the last, which is all right if the space of the design each way from the corner is carefully measured off.

Frequently it is desirable to have the pattern come out even at a certain point. In this event, when you are about five or six lengths away from this point, find out what the discrepancy, if any, will be. Divide the odd space by the number of lengths remaining, and then "steal" the necessary distance each length, extending the stencil or crowding it as required.

In designs of large figures, it is often necessary to determine the best placing of the figures before starting—so that a design, for instance, will come directly over a fireplace or over the center of a doorway. With such designs, it is better not to try to work around corners, but stop with the last full unit, and fill in the remaining space with some of the smaller figuration of the design, repeating if necessary. Care should be taken, of course, to have all of the corners look properly balanced.

"A STENCIL border certainly adds much to a room," exclaimed Mrs. Andrews, when I had finished. "How do you select the designs and colors that look so well?"

"That is a good deal the same as selecting becoming patterns and colors in anything—a dress, wall paper, or furnishings. It's a matter of good taste. Many paint manufacturers (*Continued on page 102*)

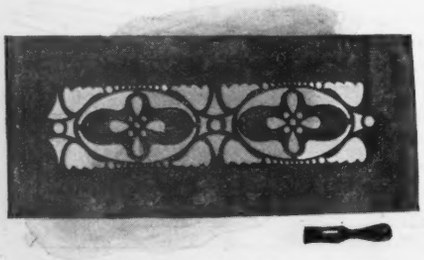


Fig. 2. A typical stencil such as may be obtained in any paint store; a stencil brush

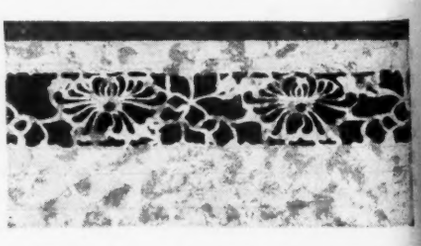


Fig. 3. A two-color border stencil applied to a wall already finished in sponge stippling

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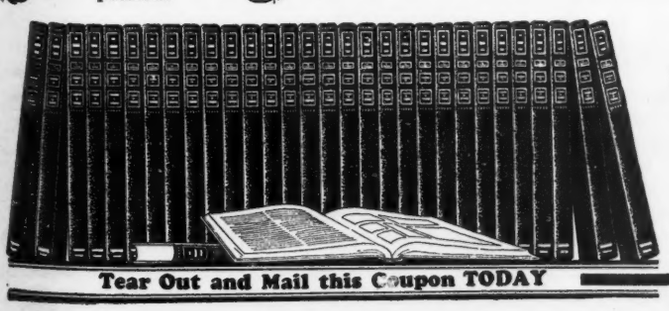

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Let's Hammer Out Some *Bowls*

It Is Surprisingly Easy to Do Decorative Work with Sheet Copper, and Little Equipment Is Needed—Further Adventures in Toolcraft

By Edward Thatcher

BLACKSMITHS and smithing always have appealed to me. In my younger days I spent much time about a carriage shop in our neighborhood. I can still remember the pleasant smell of burning hickory as the blacksmith used a red-hot iron to burn holes for tire bolts.

One day I appropriated the family bellows, built a forge of old bricks, took some hard coal from the bin in the cellar, and lighted my first forge fire. My tongs were borrowed from the "fluting iron," a simple machine much used in those days to "flute" lace curtains. I remember the joy of it when my iron got really red hot and I made my first forging.

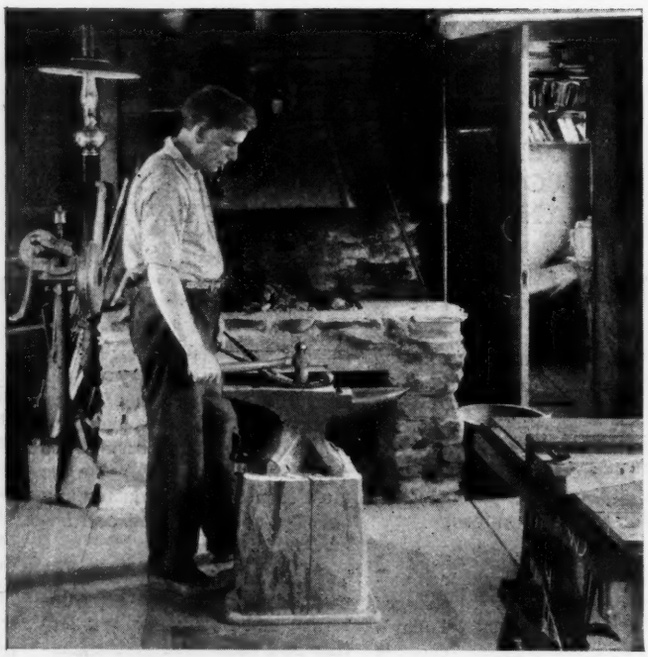
Seeing that I was determined to make things, my grandfather gave me a set of watchmaking tools. This was a great step forward and I still have some of these tools.

My attic shop lasted me through my public school days. As I grew older I took up bent or Venetian ironwork, which was then much in vogue. I remember making enough money—the first I ever earned in my shop—to buy one of the earliest phonographs that ever came to our town. It was a proud moment when I first set up this tiny machine in front of our Sunday School and played "The Queen's Trumpeters," The horn was a tin megaphone suspended from my camera tripod.

School in those days left little to the imagination. The parrot style of learning was considered the thing. We did not have manual training. Somehow I got through school where drawing, geography and history were the only things I liked.

Then I went to Pratt Institute and spent four very profitable years studying drawing, painting, and, in the latter part of my stay, interior decoration, architectural drafting and design.

The shops at Pratt attracted me very much and I spent considerable time in them, particularly the forge, foundry and machine shops, and I took short courses in some of these shops—my first real shop training.



Mr. Thatcher at the anvil in the forge end of his home workshop. He is a distinguished craftsman and specializes in decorative metal work, which he taught inspiringly for many years at Columbia University

When it became time for me to be graduated, Professor Arthur Dow, who had frequently noticed my tendencies toward mechanics, advised that I take up wrought ironwork of the decorative sort, thus combining my liking for mechanics and my training as a designer. This appealed to me strongly, so, instead of taking a position in some interior decorator's shop, I returned home, went to the junk yard, and bought an old portable forge minus a lot of pieces, for a dollar, and a cracked anvil for another dollar.

THE forge had a good blower but a totally wrecked driving gear. I removed the crank hanger, sprockets and chain from an old bicycle and rigged them up to drive the blower. One pedal with the sides removed served as a handle.

I bought a pair of tongs or two and some hammers, set my forge and anvil up in our cellar, and connected the hood of the forge to what I thought was a chimney flue. And I started work to become acquainted with the father of all the metal working arts.

As many tinkers know, it is very hard work to drill a hole through iron with a brace and bit. I had no post drill, so I made one. A post was set up in the corner of my cellar shop and on this I rigged up the screw from an old vise so that it might be screwed down on the top of my brace. A stove lid on a bracket below served as a drill plate. Crude as this arrangement was, it was a great improvement over the plain brace.

About this time my family noticed a rather smoky atmosphere in the dining room above the forge and that the lace curtains were considerably the worse. No wonder! The chimney hole to which I had connected the forge was no flue at all. This was a setback.

A friendly blacksmith, Albert Homer, gave me some tongs and hardies I sorely needed and, being a kindly sort of chap, as good blacksmiths usually are, he asked me what I was doing.

Now this blacksmith, who was the descendant of a long line of smiths in Sweden, was one of the best craftsmen it has ever been my pleasure to meet. He did not laugh or make fun of my crude efforts, but he said that I had better get some real training. He needed a helper. Why not come down to his shop and be one. Would I? Well, rather!

It made no difference to me that his shop was right on the "main street" of our town, in full view of all and sundry, or that I was supposed to be an artist and trained as such. Public opinion was very freely expressed, but much I cared.

For the best part of two years I swung the sledge over that good blacksmith's mighty anvil—about the healthiest and happiest two years that I remember. And I, who had never been a rugged youngster, found much health, happiness, and real knowledge at the forge of this friendly blond giant of a Swedish blacksmith. Many a horseshoe I helped him shape, and when we were not busy shoeing horses we took up my decorative work.

The very thorough training I received stood me in good stead. It was a solid foundation for the teaching of decorative metal work in all the years I taught this and other subjects at Columbia University. No small part of the work there was the teaching (*Continued on page 116*)

Turn to page 74 for the continuation of the Home Workshop Department

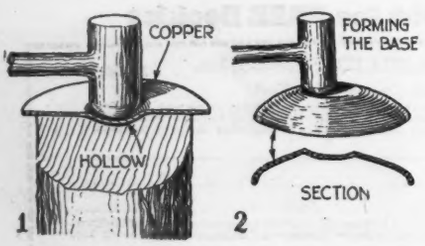


Fig. 1. The first step in doming a bowl on a block. Fig. 2. One method of forming the base

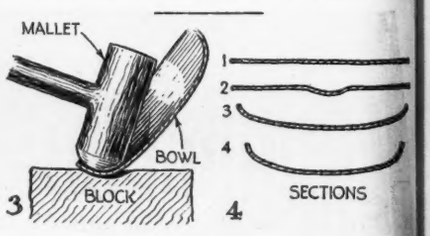


Fig. 3. Hammering the edge of the bowl. Fig. 4. Various stages of the forming process

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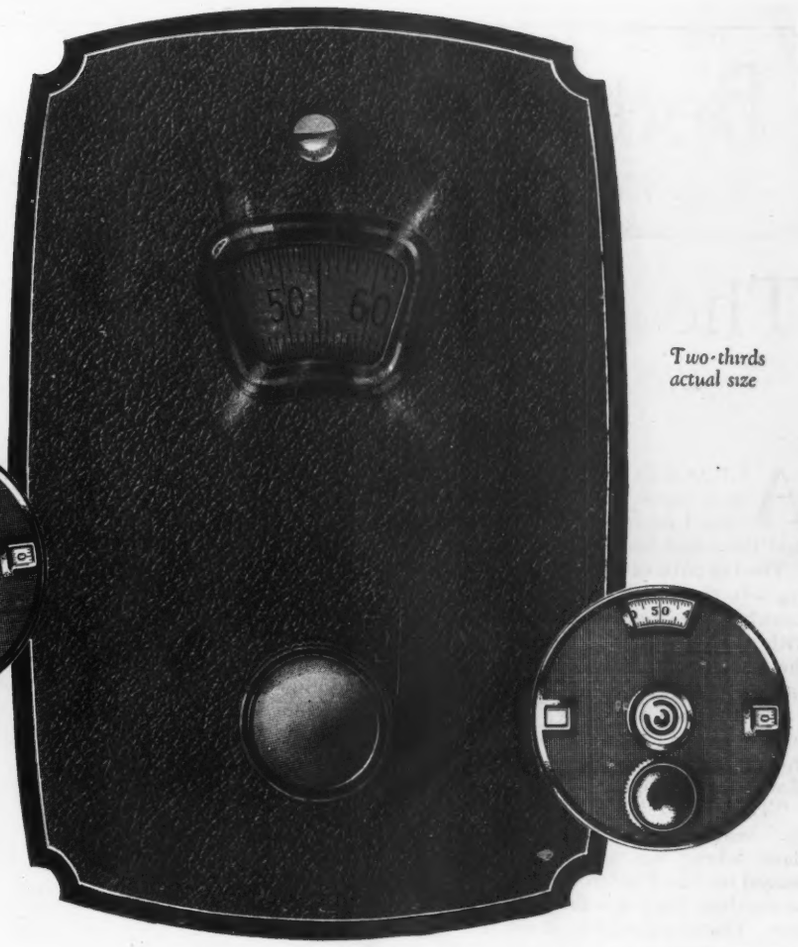

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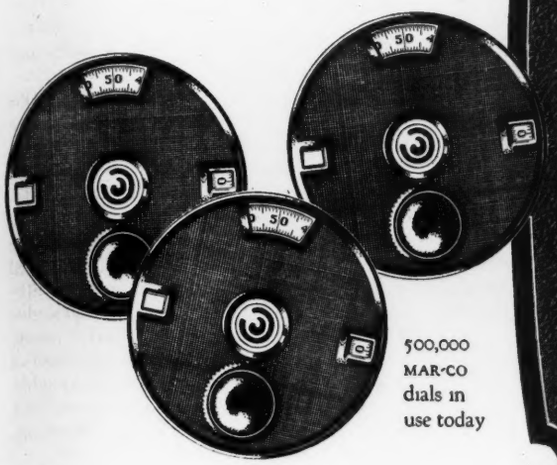

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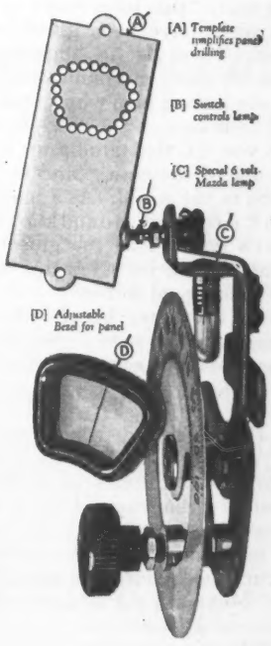

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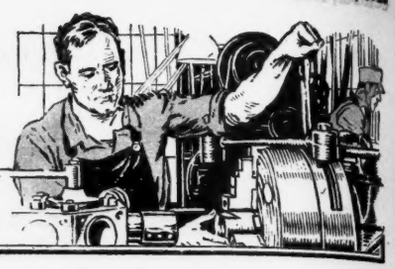
Better Shop Methods

How Expert Mechanics Save Time and Labor



The Secret of Making Glue Stick

Old Bill Tells How to Be Sure of Strong Joints in Building Up Patterns and Doing Other Woodwork—Hints on Polishing Wheels

By H. L. Wheeler
Machine Shop Foreman

A CRACKING and thumping noise in a corner of Old Bill's pattern shop told in sharp, sudden terms that there had been an accident.

The big pattern Parsons had been turning left the lathe with a thud. A glued joint had loosened and the tool had dug in with sufficient force to rip away a part of the pattern. Parsons stopped the lathe and surveyed the damage.

Old Bill, not far away, had heard the noise. He was soon at the scene of the trouble. Parsons ventured an explanation of what had happened.

"This glued joint loosened up," said he, pointing to the place where his chisel had gouged in, "and before I could do anything the job was on the floor. That joint ought to have been firm enough to hold, as it had set overnight with clamps on, and I can't account for its going to pieces in this way."

Old Bill made a quick but critical examination of the job.

"In the first place, Parsons," he said, "this joint looks as if it might have been glued better. There is an impression among many mechanics and especially among men who spend most of their time in the machine shop, as you do, that gluing up a joint is one of the easiest and simplest jobs in the world. As a matter of fact, it calls for care and knowledge. Let's go over to the glue bench and I'll give you a few tips on how to make good joints."

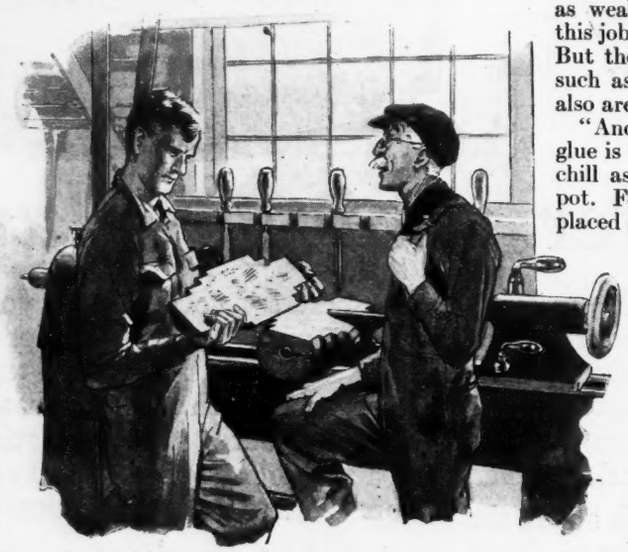
At the glue bench Old Bill found things in a mess. Brushes were not cared for properly, and the pots needed cleaning.

"I HAVE depended upon you," he said, "to watch the little things at this end of the shop, but it looks as if these gluepots hadn't been cleaned in a month. The brushes are hard, dirty and, of course, full of bacteria. It's little wonder to me that your glued joint gave way."

"Maybe it's the fault of the glue," faltered Parsons.

"That's where you're wrong," said Old Bill. "The best hide glue won't hold if you don't have it fresh and everything you use thoroughly clean. The glue must be properly mixed and heated to the correct temperature, which should not exceed one hundred and forty degrees. This gives a margin of about five degrees for cooling when taken out on the brush.

"Glue is strongest at a temperature of one hundred and thirty-five degrees, and it is spoiled by overheating. It should be mixed only in small batches, about what you think will be needed for one job. Any old glue that has stood in the pot should be removed, or it will ruin the new batch. How did you melt the glue you used on your job?"



"To use glue properly," Old Bill told Parsons, "calls for care and knowledge. Let's go over to the bench and I'll give you a few tips"

"There was a little glue in the bottom of the pot," said Parsons, "and I just warmed it and added more. It was very hot when I put it on, but probably it was too hot. I realize, after what you have said, that there is a lot to be learned about glue."

"A little of the old glue melted over might work well enough on some jobs," said Old Bill, "but when you have an important job it's best to be sure everything is right. In this case it is probably a good thing that the joint broke, rather than to have had it fail later on, as the job is for one of our best customers."

"But I don't get the idea of making fresh glue for each job," objected Parsons. "I took the pot with the least in, and there was very little. All the other pots contain glue, as you see, but I don't know how long it has stood. Why waste all that glue? I can't see that it looks any different from new glue."

"That's just the trouble," said Old Bill. "You mix too much glue at one time and waste a lot more than is necessary. Old glue that has stood for some time loses its value in this way. It decomposes so rapidly that every precaution must be taken. What is left in the pot, even if overnight, loses a great deal of its strength, sometimes as much as fifty per cent. And when mixed with new glue the bacteria makes the whole batch nearly as weak as stale glue. In the case of this job, I think that is part of the trouble. But the other things I have mentioned, such as cleanliness and proper handling, also are essential.

"Another thing to remember about glue is that it has a peculiar tendency to chill as soon as it is removed from the pot. For this reason the work should be placed as near to the gluepot as possible. Drafts from open windows or other sources should be guarded against, for glue will chill almost instantly if cold air strikes it. If the wood is cold from having stood in a cold place, it should be warmed before applying the glue. Don't forget though, that while glue cools very rapidly, it does not *set* to its full strength within forty-eight hours; often big jobs require longer time."

LATER on two or three shopmates gathered around Parsons, while he was eating his lunch, to hear news of the accident.

"The boss was a bit peeved about it," admitted Parsons, "but he gave me some good dope on glue and how to handle it, so I don't think anything like that will ever happen to me again. It was my fault for being careless when I glued the joint. Old Bill claims that improper handling will ruin any glue and I am convinced that he is right."

"I remember a job in a shop I worked in some years ago," Peters, one of the machinists, said, "that gave a great deal of trouble because the men didn't know anything about glue. A lot of expensive polishing wheels were being used and these had to be kept in condition all the time. They had *(Continued on page 126)*

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 124 to 134.

CREDIT INTERNATIONAL NEWSREEL

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World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy

ATHOL, MASS.

151

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS.

Floors	Furniture	Woodwork	Window Sills	Broom Handles	Toys and Wagons	Lighting Fixtures	Store Counters
Doors	Shelving	Closet Seats	Window Sash	Baby Carriages	Washing Machines	Bath Fixtures	Show Windows
Steps	Cabinets	Flower Pots	Refrigerators	Office Furniture	Bath Tubs outside	Kitchen Fixtures	Office Partitions
Piping	Big Building	Bird Cages	Lawn Mowers	Clothes Hangers	Golf Clubs, etc.	Ornamental Metal	Industries of
Porches	Finishing	Sun Rooms	Book Cases	Picture Frames	Fishing Rods	Steam Radiators	all kinds

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Don't throw it away LACQUER it with ROGERS

"MONEY-BACK" GUARANTY

"Try one can of Rogers Brushing Lacquer. If not MORE *than satisfied, return what is left in the can to your dealer. He is authorized to refund the entire purchase price."*

THOUSANDS and thousands, daily, are adopting this new, guaranteed Rogers Brushing Lacquer—so simple to apply—produces such amazing results—and offers so many rich and beautiful color effects.

It's just *fun* to "lacquer" with Rogers. There is no tedious preparatory work—no muss—no confusion. "Hands off" signs are not needed.

You simply apply Rogers Brushing Lacquer, with a brush, right over the old finish. It spreads out smoothly—covers evenly, showing no laps or brush marks—and *"Dries While You Wait."*

You lacquer a dressing table or dresser and use it in half an hour. You lacquer a chair and sit on it 30 minutes later. You lacquer a floor and walk on it in a few minutes.

Adheres to new wood, metal, glass or any old surface. And the beautiful, glossy finish is *practically indestructible!* Wears and wears and wears. Becomes more satiny and lustrous with use.

There are literally hundreds of uses for Rogers Brushing Lacquer in every home, store, office, factory, building and in many industries. Try it today and see for yourself.

Dealers everywhere sell "Rogers" in the Oriental can. Comes ready mixed and ready to use, in a wide range of rich and beautiful lacquer colors. Also black, white and clear. Demand the genuine—the kind sold on a publicly advertised "Money-Back" Guaranty.

DETROIT WHITE LEAD WORKS, *Detroit, Michigan*
Makers of Highest Grade Paints, Varnishes, Colors, Lacquers

Also distributed and guaranteed by

ACME WHITE LEAD AND COLOR WORKS
Detroit, Michigan
LINCOLN PAINT AND COLOR COMPANY
Lincoln, Nebraska
THE MARTIN-SENOUR COMPANY
Chicago, Illinois
PENINSULAR PAINT AND VARNISH COMPANY
Detroit, Michigan
THE SHERWIN-WILLIAMS COMPANY
Cleveland, Ohio

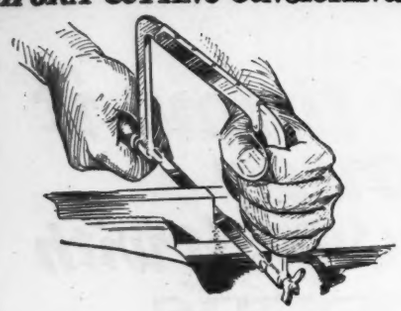
ROGERS
THE MARK OF QUALITY

LACQUER

28

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

UNIFORM CUTTING CONSISTENCY



Star Hack Saw Blades have proved their cutting qualities during the last half century and the users of these blades know they buy in each blade an even, uniform cutting consistency.

The Star Special Flexible Blade combines this cutting efficiency with the flexible qualities you have never experienced in any other blade.

WRITE FOR FREE SAMPLE BLADES

Clemson Bros., Inc.
Middletown, N. Y.

MAKERS SINCE 1883

STAR HACK SAWS

TRADE MARK

The Home Workshop

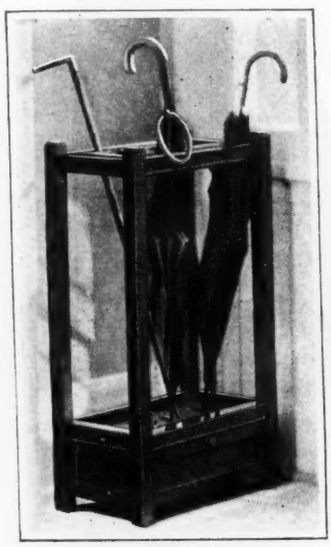
At Last—a Place for Rubbers

Special Compartment for Them Is Built into Umbrella Stand of Neat and Simple Design

By WILLIAM W. KLENKE
Instructor in Woodworking, Central Manual Training High School, Newark, N. J.

FRANK, one of the boys who worked in the shops at Central High School and was especially interested in woodwork, came to visit me at my home one Saturday during a light summer shower. I suggested that he put his rubbers and umbrella in the stand I had made for that purpose.

"Well," said Frank, "that's something new to me — a combination umbrella and rubbers stand. Mother has always wanted a place to put our rubbers as well as umbrellas. I guess I'll try to make one for her birthday. Will you show me how to go about it, Mr. Klenke?"



Neat and simple umbrella stand in mahogany, made by Mr. Klenke

"Certainly, Frank. I have a blueprint in my desk with the list of materials and all necessary details. Here it is. Of course, in getting out your rough stock, you must allow for dressing up the pieces to the exact size. Plane all the pieces true, with good, square ends on the rails for the dowel joints."

"I suppose I should mark on the various pieces, right front, left side, and so on," said Frank.

"That's right. Then, to lay out joints, place each leg and rail that are to be jointed together in turn in the vise with the working faces out. Using a marking gage, make the center line. With a knife and try-square, cross this line in two places, locating the centers for two dowels. By this method you are sure to get the points on both pieces alike. Now, using a number six auger bit—"

"That means a three-eighths-inch bit, doesn't it?" asked Frank, eagerly.

"Yes, auger bit numbers increase by sixteenths of an inch," I answered. "With this bit bore holes three-quarters of an inch deep at each intersection."

"Shall I use a bit gage for depth?" questioned Frank.

"If you care to use one, but you must be careful not to mar your joint as it turns. I prefer to count my cutting turns. For every full cutting turn in the average wood, I figure the bit will enter one-sixteenth inch."

"In other words," said Frank, "twelve cutting turns."

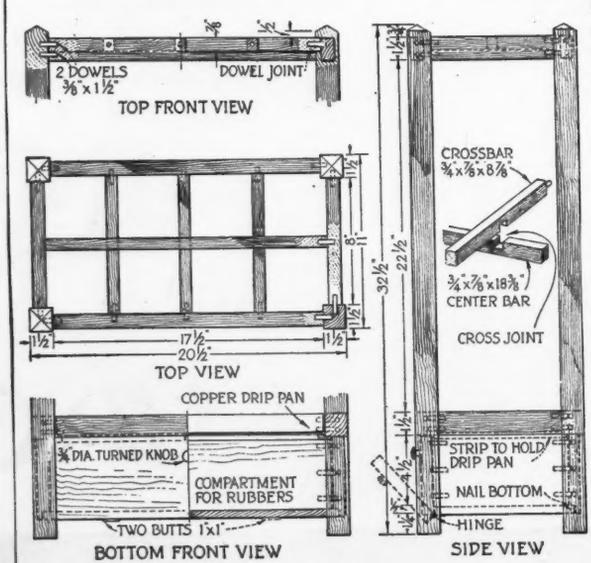
"That's correct. Bore the holes in all pieces, then cut the dowels to length. I either countersink the holes or chamfer the top of the dowel to make it easier to put the joints together. You remember from making tables that you do the gluing at two different times. I should glue up the two short ends first with good hot glue or the best grade of liquid glue—not too thick—then the next day glue up the entire job."

"Do I have to glue up the framework at the top separately?" Frank asked.

"You may if you wish to, but I prefer to do it all at the last gluing; it is easier to get the entire piece square while the top is not rigid. Either way, however, will work out satisfactorily. When set, clean off all the glue and sandpaper thoroughly."

"Shall I use our regular bichromate of potash solution for staining?"

"Yes, Frank. If you want a brown tone on the mahogany, (*Continued on page 113*)



The working drawings Frank had to follow. The construction is a trifle simpler than that shown in photographic illustration

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Many a "radio evening" depends on this moment

THE moment you pay for a radio battery, you pay for something more than "just a battery." You are investing your money in many evenings of radio pleasure . . . or disappointment. You must get a battery that will give you trouble-free service and good, clear radio reception.

Prest-O-Lite Storage Batteries, made especially for radio use, have back of them more than twenty years of manufacturing experience. They are honestly made, only the finest materials go into their construction. They have been perfected in the world's largest electro-chemical research laboratories.

When you select a Prest-O-Lite "A" or "B" Storage Battery you are certain of getting real battery value. You are certain of getting batteries that can be depended upon to deliver their rated ampere-hour capacities. This lengthens the time between charging and assures good, clear reception.

Prest-O-Lite Batteries are attractively priced from $4.75 up. So that it is no longer necessary to take a chance on batteries of unknown make. There's a man who sells them near you.

THE PREST-O-LITE CO., INC.
INDIANAPOLIS, IND.
New York San Francisco
In Canada: Prest-O-Lite Company of Canada Ltd., Toronto, Ontario

Send for free booklet

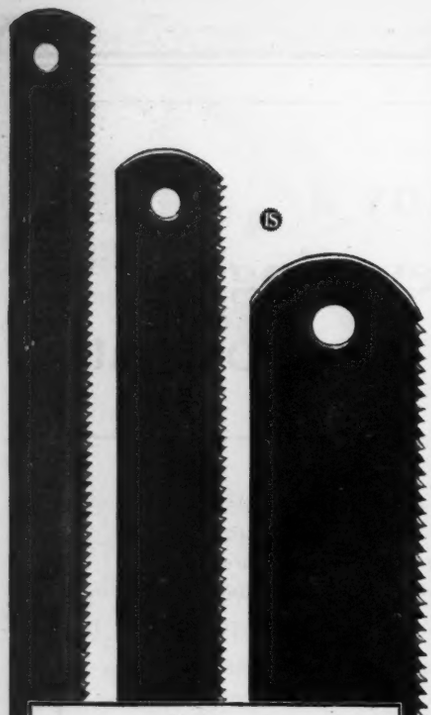
"What every owner of a radio should know about storage batteries" is a little booklet which every radio fan will find interesting and helpful. It is crammed full of hints that will bring surprising radio results—and save you money. It's yours for the asking, without obligation.

Designed especially for radio

Prest-O-Lite

STORAGE BATTERIES FOR MOTOR-CARS AND RADIO

(S) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS



"ATKINS"
Better Blades to Cut Any Metal

NO matter what metal you cut—it will pay you to be sure the ATKINS name is on the blade. Only genuine ATKINS Hack Saw Blades pass the " file test " to insure you easier, faster, surer metal cutting. ATKINS steel and tempering save you time, labor and money.

ATKINS Hack Saw Chart, showing the best blade for every use, and the interesting book "SAWS in the SHOP" will be mailed free.

E. C. ATKINS & CO.
Established 1857
Leading Manufacturers of Highest Grade Saws for Every Use; Saw Tools, Saw Specialties, Plastering Trowels, and Machine Knives.
INDIANAPOLIS, U. S. A.

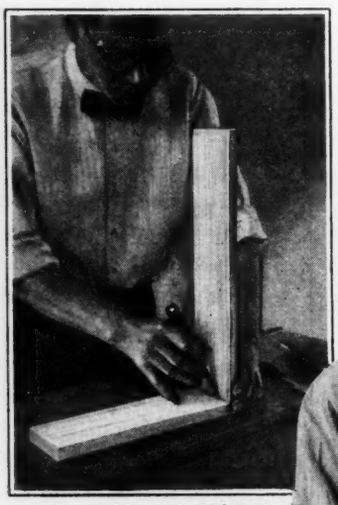
ATKINS
METAL CUTTING SAWS

The Home Workshop

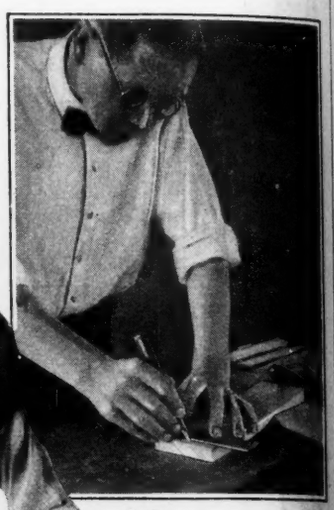
DOVETAILS—The Wonder Joints of Woodworking

By EMANUEL E. ERICSON, *Noted Manual Training Authority*

AS SOON as you have mastered the making of a dovetail joint, the strongest and neatest of all glued joints, you can call yourself a real cabinetmaker

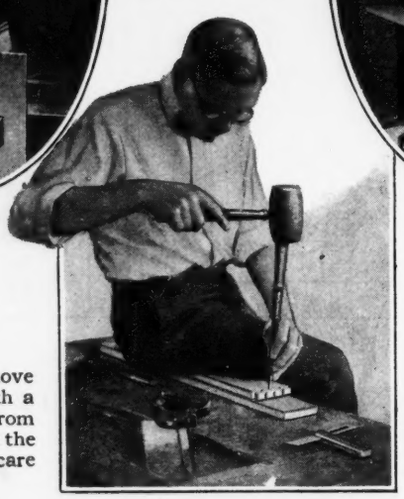


1 In making a half-blind dovetail (as for a drawer), mark the thickness of each side on the front



2 Square across and gage line on end for the distance side is to lap over front

3 On side pieces mark length and angles (15 or 20 deg.) of tails



4 Cutting tails with fine back or dovetail saw. Several pieces at a time can easily be cut

5 (At right) Remove waste wood with a chisel. Work from both sides and split the lines with great care

6 Transfer exact shape of tails to the front member by holding the pieces in position and marking with a knife. Continue lines on inside down to the cross line, which was drawn with square and knife as illustrated in Fig. 2

IF YOU will pull out one of the drawers of almost any well-built piece of furniture, you will find the front and sides are fastened together with a multiple dovetail joint—the aristocrat of wood joints. This is at once one of the strongest and neatest of fastenings at the command of a cabinetmaker.

It can be made in three principal forms —the half, half-blind, lapped or stopped dovetail, as at the front corners of a drawer; the through dovetail, as in high class boxes, chests and cases and sometimes at the back corners of drawers; and the mitered or secret dovetail, which outwardly looks the same as a mitered joint.

There are many ways of making dovetail joints. The ex- (*Continued on page 108*)

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CLEAR at a whisper....

CLEAR at the volume of a brass band....

REAL!

RCA Loudspeaker 102 adds a *power unit* to the Model 100. Plugged in on the house current, it has power to deliver almost any volume of tone—clear and undistorted. (For use on 50 to 60 cycle, 110 volt A. C. lighting circuit.) $140

RCA Loudspeaker 100 gives clear, mellow, undistorted tone up to any volume your set can give it. It is really the only loudspeaker to buy when you use the *power* tubes $35

TURN it low—use the great power as a reserve to get the climax of a song without a crash. Turn it higher—let the dance music sound out clearly above the talk and the shuffling of feet. Or use it in a great hall—and get the actual volume of a great orchestra. Every instrument is real! With RCA Loudspeaker 104—get *natural* tone and *natural* volume.

RCA Loudspeaker 104 is not only a power loudspeaker, but eliminates the "B" batteries of most sets. With RCA Radiola 25 or 28, it can be adapted to eliminate all batteries. It operates on the 50 to 60 cycle, 110 volt A. C. lighting circuit $275

RCA

RCA Loudspeaker

MADE BY THE MAKERS OF THE RADIOLA

RADIO CORPORATION OF AMERICA · NEW YORK · CHICAGO · SAN FRANCISCO

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Is This Tobacco a Part of Every College Education?

Considering the recent discussions pro and con on the value of college education, it is interesting to hear from an old graduate who found at least one subject useful in later life. That was pipe-smoking.

Read his letter:

Larus & Bro. Co.
Richmond, Va.

It was at college that I learned to smoke Edgeworth. Of course I also learned a few other things at college. One was to play football. Another was to study the dead languages. Now, fifteen years later, I have given up playing football and studying dead languages, but have not yet given up smoking Edgeworth tobacco.

It was a sort of tradition for each fellow as he threw off the toga of boyhood and put on the cloak of young manhood to adopt the smoking of Edgeworth as a symbol of his entrance into man's estate.

Being fortunate enough to enjoy the surpassing mildness and sweetness of Edgeworth right at the threshold of his smoking career, each young fellow as a general rule found any other tobacco unsatisfying, and adhered to Edgeworth year after year. When I have met some of them many years after, I have often inquired:

"Still smoking Edgeworth?"

Almost invariably the answer has been "Yes; I still like it better than any other; it's got a very pleasant flavor. And it's mild; it never burns the tongue."

(Signed) FRANK H. WILSON.

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10-V S. 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth station. Wave length 256 meters.

The Home Workshop

Amazing Puzzles Formed from Easily Whittled Blocks

By ARTHUR L. SMITH

BLOCK puzzles may be made of combinations of the six-block puzzle described in the March, 1926, issue of POPULAR SCIENCE MONTHLY. They may be of more or less intricate character according to the solutions there offered.

As such a puzzle is apt to be quite intricate enough for the average person, no matter how simply constructed, we shall choose one of the easiest of the solutions (corresponding to No. VI in the first article). If extreme intricacy is desired, several of these solutions can be embodied in one puzzle, but such puzzles often lose their entertaining character since even the constructor may forget how to put them together.

The blocks used are ½ in. square and 4 in. long. The cuts are ¼ in. deep and ¼, ½ or 1 in. long.

For a six-block puzzle (Fig. 1) to be inclosed in one of twenty-four blocks (Fig. 3), making one of thirty blocks altogether, (Fig. 5), the cuts are central as shown in B, C, D. For the twenty-four block puzzle the cuts are equidistant from the ends as in E, F, G. The illustration makes the character of the cuts and their positions sufficiently clear.

By making the six-block puzzle (Fig. 1) first and putting it together, the solution of the twenty-four block puzzle is practically mastered, for the assembling is the same in each case. It will require blocks put together in the order named: C, B, D, D, D, A. Fig. 2 shows the puzzle partly assembled.

Four A's, four E's, four F's and twelve G's will be required for the twenty-four block assembly shown in Fig. 3.

To put it together we first take F, F with E fitted in the cuts at the farther end. Then G, G and G, G are fitted in pairs on the E and F's. Another G is placed opposite E, binding the two G pairs. Fig. 4 shows these G pairs with E, G binding them at the bottom.

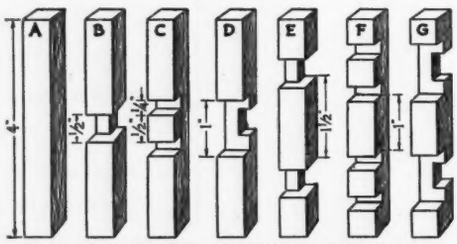
Unless the assembling is done in this way, one may find that more than two

(*Continued on page 105*)

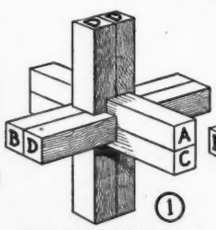
Not Hard to Make

IF YOU like to solve really ingenious puzzles—and who does not?—you will find the problems outlined by Mr. Smith in this article among the most fascinating of their kind.

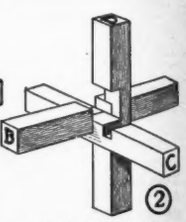
While Mr. Smith was led to write this article because of inquiries from readers who wished to put together twenty-four block combinations, it is not necessary to have read his preceding articles to understand the procedure in making and solving these puzzles. To whittle the blocks requires only a sharp pocketknife, a strip of ½ in. thick pine, mahogany or other straight grained wood, and a little care and patience. And once made, the blocks will prove a source of never ending amusement and astonishment to your friends.



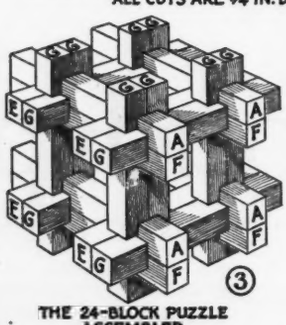
BLOCKS REQUIRED FOR THE 24 AND 6-BLOCK PUZZLE ALL CUTS ARE ¼ IN. DEEP



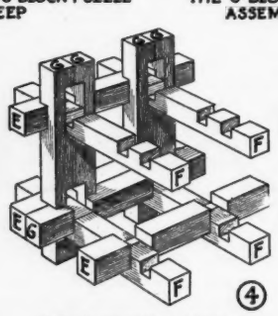
THE 6-BLOCK PUZZLE ASSEMBLED



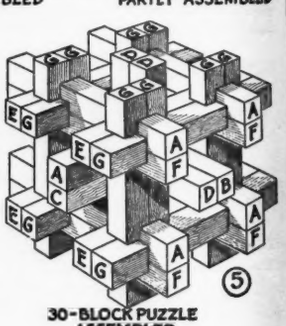
6-BLOCK PUZZLE PARTLY ASSEMBLED



THE 24-BLOCK PUZZLE ASSEMBLED



THE 24-BLOCK PUZZLE PARTLY ASSEMBLED



30-BLOCK PUZZLE ASSEMBLED

Intricate as the puzzles in Figs. 1, 3 and 5 appear to be, they are made by combining blocks 1 in. square and 4 in. long, whittled to the shapes shown in the upper left-hand corner of illustration

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Artistically, this new Amplion Cabinet Cone graces the most exquisitely appointed drawing room—acoustically, it sets a new standard in radio reception.
AC12 . . . $30

HERALDING~ a New Radio Voice

When genius sings or speaks or plays—a breathless silence follows.

When the new Amplion Cone reproduces vocal or instrumental tones—an awed hush ensues.

AMPLION PATRICIAN

A new model of the air column type—as pleasing to the eye as to the musical ear. Non-directional general diffusion of sound. 48-inch air column in an 18″x12″x9″ cabinet.

AA18 . . . . $45

AMPLION DRAGON

The world's "best seller"—adopted as the standard among leading radio engineers for experimental and comparative tests. Famous for its sensitivity to speech and musical signals, and for volume without distortion.

AR19 . . . . $42.50

For this new type of cone, designed by the engineering genius of the world's largest makers of sound reproducing devices, sets an entirely new standard in radio reception.

A precision of sound-values—a mellow clarity—an utter absence of distortion or "chattering"—characterize the new Amplion.

Built on an entirely new principle of *balanced* construction and exceptionally responsive to the weakest signals, the new Amplion reproduces the entire vocal and musical range with an astonishing purity, combined with the utmost volume.

Sensitive as a deer to the faintest sounds, this Amplion sets a new standard of reception for every set. It is the last link in the chain of quality broadcasting.

As you listen in—to classical music or jazz—to symphony concert or brass band—to speakers or singers—it becomes increasingly difficult to tell the difference between the actual performance and *the new radio voice!*

Write for the interesting Amplion Booklet

AMPLION Ⓢ

THE AMPLION CORPORATION OF AMERICA
280 Madison Avenue, New York City
THE AMPLION CORPORATION OF CANADA Ltd., Toronto
"The House of Graham" is known throughout the world, through its associated companies

From 1887 . . . . . A Path of Brilliant Achievement . . . . . to 1927

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS See page 6.

Wood-Carving Made Easy

With a Set of the Famous London Addis Carving Tools

Wood-carving is easy **if the right tools are used.** And fortunately a complete set of the essential tools can be bought at a price so moderate that the beginner can afford to equip himself with a very fine set right at the start.

Whether a beginner or an expert you will find the tools you need in the kit pictured below.

With this seven-piece outfit you can embellish ship models with beautiful carved work—you can easily and quickly decorate chests, chairs, tables or any of the other furniture that is described in the Home Workshop Department of this magazine. You will find wood-carving a fascinating hobby—and a source of income if you want to sell your handiwork.

The complete set consists of a stencil chip carving knife . . . Arkansas Stone . . . ½" parting tool . . . 1/16" veining tool . . . ⅛" deep gouge . . . ¼" flat gouge . . . ¾" broad gouge. These tools with the specially designed sharpening stone are packed in a durable kit made of stout brown canvas. The complete set, including the canvas kit and sharpener is $4.30.

Send today the coupon below with your remittance for $4.30 and we will send you, **the day your order is received,** the complete kit—postage prepaid. We guarantee that if you are not satisfied **in every respect,** we will refund your remittance without argument or delay.

CHAS. F. BINGLER SONS
182 Sixth Avenue,
New York, N. Y.

CHAS. F. BINGLER SONS,
182 Sixth Avenue, New York City.

Dear Sir:
Enclosed is $4.30 for which please send me by **return mail** your Kit of famous Addis carving tools. It is understood that if I am not satisfied in every particular you will return my money.

Name.....

Street.....

City and State.....

The Home Workshop

A Beautiful Clipper Ship

(*Continued from page 65*)

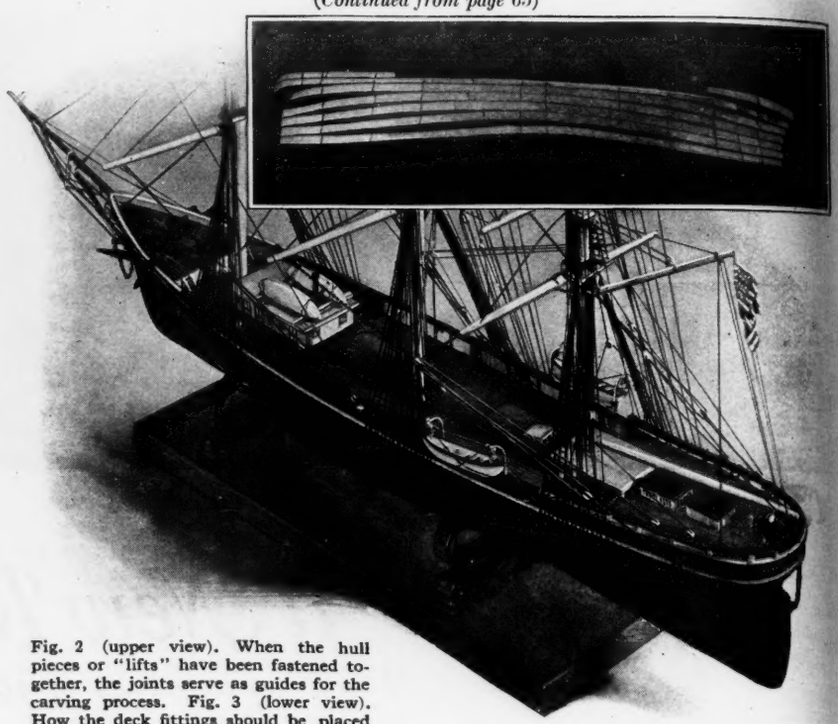


Fig. 2 (upper view). When the hull pieces or "lifts" have been fastened together, the joints serve as guides for the carving process. Fig. 3 (lower view). How the deck fittings should be placed

a run between Honolulu and New York she made 411 miles in one day, 1478 in four days, and 3562 miles in 11 days, or an average, allowing for the difference in time, of 13¾ knots. On another run, she sailed from New York to Liverpool in 13 days 23 hours, which has never been equaled in the month of June.

The *Sovereign of the Seas* was sold to a Hamburg firm and was wrecked on the Pyramid Shoal in the Straits of Malacca, August 6, 1859, becoming a total loss.

Her length at the load-line was 231 ft., which, at the scale of 1/12 in. to the foot, gives us a model 19¼ in. long at that line, or 26 in. long and 16½ high over all. This is a comfortable size for the average room. To make it smaller is not advised, but it can be made larger by increasing all the measurements proportionately.

The first necessity is a full sized drawing of every part to be made. You can save yourself the formidable and time-consuming task of making these drawings by sending 75 cents to the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York, for Home Workshop Blueprints Nos. 51, 52 and 53 (see page 92). These contain the original drawings used in the construction of the model, which, with the exception of some smaller explanatory sketches, are all full size, including the rigging plan.

Too many models are ruined by trusting to the unaided eye, so measure each part carefully, and endeavor to keep down to the measurements.

It is well to make clear here that the writer does not claim that everything in the model is an exact replica. Authoritative plans and contemporary pictures have been used in the designing, but some fittings can only be given as probable and it is not always possible to adhere to exact scale. For example, the skysail yards should be 1/24 in. in diameter and the braces for those yards should be no thicker than the finest sewing silk, but it is advisable to make such parts slightly overscale. As another example, the deck plank markings should be thirty-six to the inch, which (*Continued on page 82*)

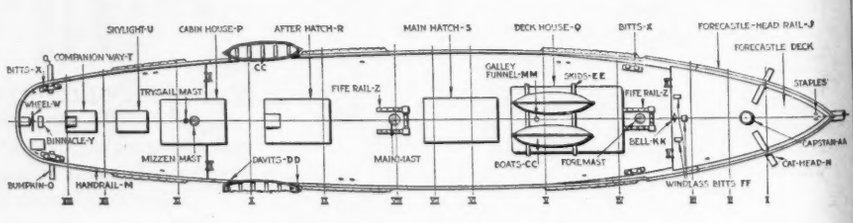


Fig. 4. Plan view of the deck showing the fittings. This plan is given full size on Blueprint No. 52. In addition, this blueprint has the complete details of the deck and cabin houses and various parts

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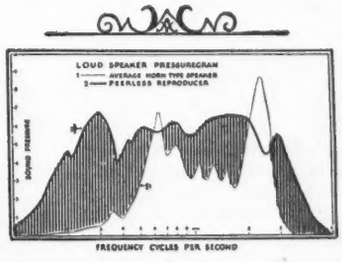
TRADE-MARK
Peerless
REPRODUCER
PRODUCT OF UNITED RADIO CORP. ROCHESTER, N.Y.
NODAL AREAS OR DEAD SPOTS
BROKEN VIBRATIONS DUE TO NODAL AREAS
DIAGRAM OF TYPICAL SPEAKER
EDGE FREE AND UNCLAMPED
UNBROKEN VIBRATION OVER ENTIRE SURFACE OF CONE
EDGE FREE AND UNCLAMPED
DIAGRAM OF PEERLESS SPEAKER

A strange trick of the human ear

may be robbing you of half your radio pleasure

FROM infancy, your ears have heard music direct from some *original* sound-source. Listening directly to an organ, a violin, a piano, or a band, your ear caught all the overtones and harmonics. Subconsciously you *memorized* the sounds with every fine harmonic shading.

Today, when you sit before your radio, if your loud speaker fails to reproduce the high harmonics or the low throbbing bass, *your imagination supplies the missing frequencies!* You think you are really *hearing* what actually you are only *remembering!* Without knowing it, you are *straining to hear!* "Listeners' Fatigue" results. You miss half the beauty of the original rendition trying to hear what your speaker will not reproduce.



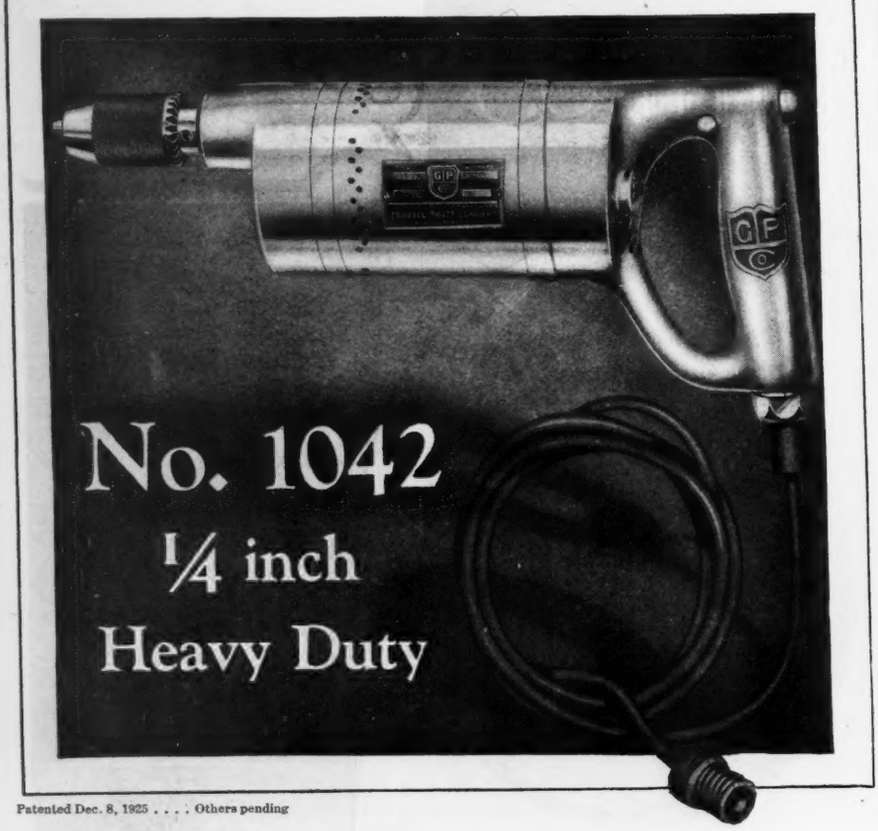
A comparative frequency chart of two speakers in operation. One a typical horn type. The other, the Peerless Reproducer. The red-shaded areas show exactly what you *miss* with old-type speakers—and what you *gain* with the Peerless Reproducer.

The new Peerless Reproducer gets these formerly "Lost Frequencies." How much more than the average, the chart shows. A new principle is responsible for this amazing result. The small diagrams above *show* its fundamental differences but only a Comparative Demonstration will *prove* these differences to your ear. This demonstration is free, but will be a revelation. It may be heard in the stores of two thousand Peerless dealers from coast to coast, and in Canada.

Meantime, send for a booklet of tell-tale loud speaker facts. Just ask for "Voices from the Air" on a post-card or in a letter. Or merely write your name on the margin of this page and mail it. The booklet is *informative!*

UNITED RADIO CORPORATION, ROCHESTER, NEW YORK

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



Patented Dec. 8, 1925 . . . . Others pending

Motorize your Workshop with an Electric Drill

A GOODELL-PRATT Electric Drill will double the joys of your workshop.

Besides being efficient, powerful machines for fast drilling in wood or metal, they are in reality portable power plants that any ingenious craftsman can adapt to drive light lathes, bench saws, polishing and grinding heads, jig saws, bench planers, etc.

Just think of the innumerable possibilities such a shop offers. How much more fun you can get out of it with power-driven equipment to do the roughing out and uninteresting parts of your work.

Goodell-Pratt Electric Drills are made in six sizes with Universal Motors for either Alternating Current or Direct Current at 110 or 220 Volts.

Write for descriptive folder and prices.

The Goodell-Pratt Electric Drill is made in

¼ Inch Heavy Duty
⅜ Inch Heavy Duty
½ Inch Light Duty
½ Inch Standard
½ Inch Heavy Duty
⅝ Inch Heavy Duty

Powerful motor; long, patented, high-speed, self-oiling armature bearings; wide-faced, specially heat treated gears that run in bronze bearings; new self-tightening chuck; ample ventilating system; quick accessibility of all parts; handy switch control and absolute cleanliness — these are some of the improvements that make the Goodell-Pratt Electric Drills truly remarkable in performance and wonderfully free from trouble.

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

MAKERS OF Toolsmiths MR. PUNCH

GOODELL-PRATT
1500 GOOD TOOLS

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The Home Workshop

A Beautiful Clipper Ship

(*Continued from page 80*)

would only result in a mess of lines.

The body of the hull (Fig. 1) is constructed of six lifts or layers, each 5/12 in. thick (that being the usual thickness of planed ½-in. white pine). To make them, take six pieces of such white pine, free from knots, not less than 3½ by 20 in., and scribe a midship line right around the center of each. Mark one of the outlines A, B, C, D, E, and F on each.

The best way to do this is to transfer the lines directly from Blueprint No. 51 to the wood by means of typewriting carbon paper. Mark at least three of the construction lines on the under side of each lift, say Nos. II, IX, and XII. Another way is to make a tracing for each lift and paste it temporarily on the wood to be sawed out.

Cut these pieces to shape with the fret saw, being very careful never to come inside the lines; it is better to leave about 1/32 in. of wood outside them. Sandpaper off all inequalities. The bottom lift

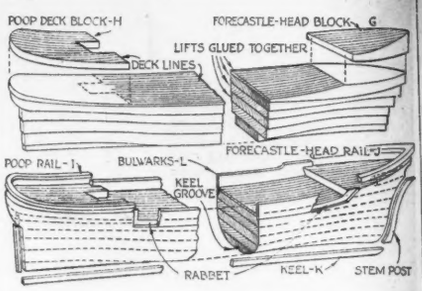


Fig. 5. How the "lifts" are assembled; the bulwarks, rails, stem, sternpost, and keel

(A) is only 4/12 in. thick; the extra should be planed off before cutting.

The 1/12 in. is the old-fashioned "line" measurement, which will be found on some rules. The scale with twelve divisions to the inch has been drawn on Blueprint No. 51 and can be cut out and pasted on a rule or strip of cardboard.

To make the model hollow, lifts B, C, D and E may have their centers cut out. To do this mark the top of the piece underneath on the bottom of each and with that side up, saw to keep at least ¼ in. within the line.

The pieces project at the ends to form the stem and sternpost; these may be cut off and vertical pieces fitted after the hull is shaped. The keel comes later.

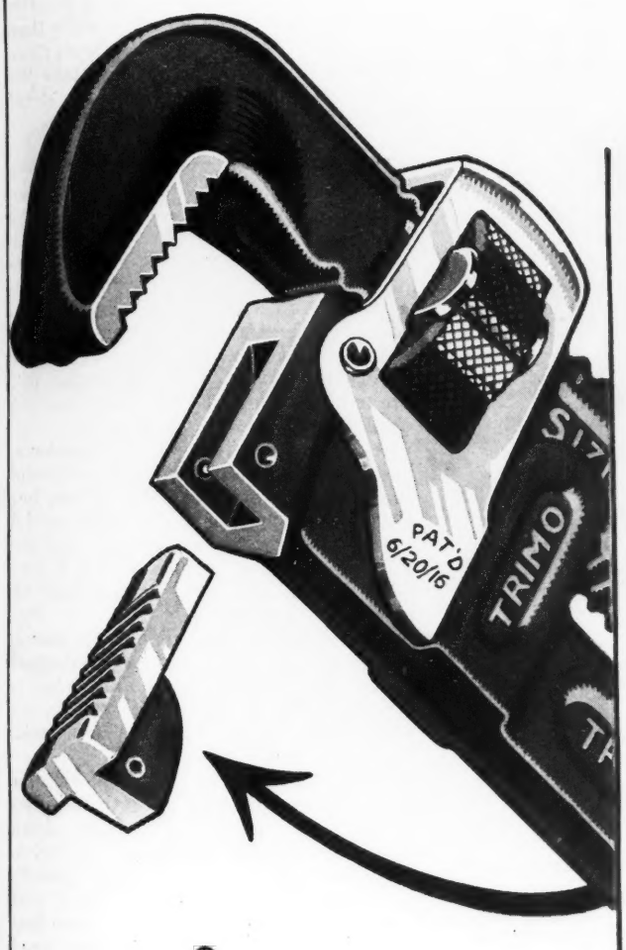
Glue the lifts together most carefully (Figs. 2 and 5), so that the midship lines make one straight vertical line, and so that the construction lines coincide exactly. To do this in one operation, I found it easiest to start at the bottom lightly nailing each piece to the next, on the inside, as it was placed, and making sure that no nail heads projected.

When this is done, put the whole in clamps or under weights and set aside to dry for at least 12 hours.

Next cut the sheer or curve of the deck line. This starts forward between III and IV (Fig. 1) and continues to the stern. The deck should have a slight camber or downward

(*Continued on page 84*)

TRIMO



The Pipe Wrench *with the* Replaceable Insert Jaw *and* Nut Guards

WHEN large American tool buyers (railroads, oil companies, power plants, plumbers, etc.) have to settle the question of wrench economy, TRIMO almost invariably gets the verdict, even though the first cost of this rugged Pipe Wrench is a few cents more than others. Why is this?

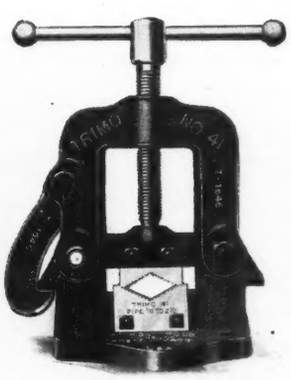
Just consider one point alone—the INSERT JAW in the handle, an exclusive TRIMO feature. After the TRIMO has rendered long and hard service, this jaw can be quickly replaced at small cost. With other makes an entirely new wrench would have to be bought. NUT GUARDS which keep the TRIMO adjusted constitute another economic (time and labor saving) feature. Pressed steel frame is practically unbreakable.

Replaceable parts, maximum strength, masterly design, and many other exclusive points have made TRIMO the preferred Pipe Wrench among large and small users for nearly 40 years. Made in eight steel-handle sizes from 6 to 48 inches; four wood-handle sizes, 6, 8, 10, and 14 inches.

At all hardware, mill, plumbing, and oil-well supply stores. Insist on TRIMO—accept no other.

TRIMONT MFG. CO.
ROXBURY - MASS.

TRIMO PIPE VISE



A HANDY, rugged tool for home, shop, or farm. Has tempered, tool-steel jaws with fine-milled teeth which grip firmly. Yoke, frame, and base are of guaranteed malleable iron. Screw, head, and handle are of selected steel. Patented device insures smooth hand grip. Made in seven standard sizes. Absolutely guaranteed.

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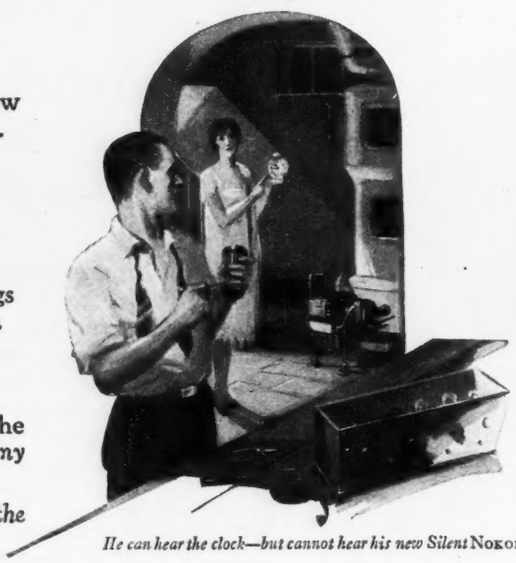
What about this Silent NOKOL automatic OIL HEAT?

It is a sensational new discovery in home-heating comfort

FREE:
Coupon below brings valuable new book



He can hear the clock—but cannot hear his new Silent NOKOL

HERE are some facts about the most modern oil heat for *any* home:

Noise has now been cut to the vanishing point.

High efficiency, which for nine years past has established records for *lowest-cost, fully automatic oil heat—is now actually increased.*

More comfort than ever before is delivered at the same low cost.

Right now, as a result, shrewd American home-owners are investing *one-and-a-half million dollars—monthly*—in Silent NOKOL installations.

More than 35,000 homes have had NOKOL comfort *for periods up to nine years!*

What it offers:

NOKOL-owners usually *pay less for their heat* than hard-coal would cost; *never more.*

There is not, never has been, "oil-burning" odor in or about any NOKOL-*heated home.* Because NOKOL *does not have to burn* low-grade, foul-smelling fuel to provide *low-cost* heat!

This comfort is for *small* homes, or *large.* NOKOL is one of the few automatic oil burners made in sizes to suit *any* home.

New Book—FREE

Send coupon below and learn where, in *your own vicinity,* the new Silent NOKOL may be seen. You will also receive, free, a valuable new book on Oil Heat.

(Silent NOKOL exhibit at Philadelphia Sesqui-Centennial—now: PALACE OF LIBERAL ARTS, Group "D")

FREE: *New* OIL HEAT *Guide*
AMERICAN NOKOL COMPANY,
Dept. 19—215 N. Michigan Ave., Chicago
Gentlemen: Please tell me where to see the new Silent NOKOL in this vicinity. Also send—free—new book.

Name.....
Address.....
City.....State.....

The new Silent NO COAL NOKOL
AUTOMATIC OIL HEATING FOR HOMES

First domestic oil burner listed by Underwriters' Laboratories; approved by all leading safety boards. Manufactured and guaranteed by AMERICAN NOKOL COMPANY, Chicago

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The Home Workshop

A Beautiful Clipper Ship

(*Continued from page 82*)

curve from the center line toward the sides.

This is a convenient time to pencil the lines to represent the edges of the deck planks. They are marked about 1/10 in. apart with a very hard, sharp pencil and should run truly fore and aft.

Make the pieces G and H (Figs. 1 and 5) for the forecastle and poop. G is ¾ in. thick at the bow and ¼ in. at its after end. The top is considerably wider than F, to allow for the flare at the bow. Piece H has a square cut out of it to take the cabin house; it flares out at the stern. Glue these in place.

FROM thin cardboard cut 13 templets from the vertical profile body plan (Fig. 1). Fix the hull on its side in the vise, being careful not to bruise it with the jaws. Shave away the lower corners of the lifts until you are down to the upper joints of each. While doing this keep trying on the templets, noting especially that the curves in some places, as at the lower part amidships and upper part aft, are convex and at the ends concave (hollow).

A chisel, flat gouge, plane, spokeshave, and half-round cabinet rasp are all useful in this work, especially the latter, but not all are necessary. Be very careful with the hollow under the stern and the flare at the bow. You will find a very beautiful and absolutely correct hull will emerge.

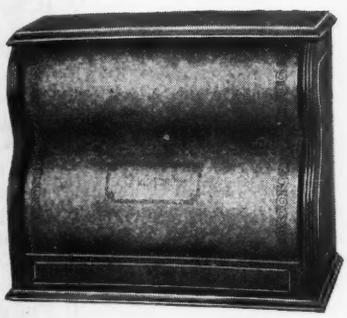
If the ends have been left on the pieces, be careful with them and have a distinct angle between the end posts and what is supposed to be planking. If you have cut them off, leave the ends flat enough to take the posts—a full ⅛ in.

The bulwarks (L, Figs. 1 and 5) come next. Cut rabbets 3/32 in. into the sides of the hull and extending 3/16 in. down from the deck line, as shown in Fig. 5. Into these fit pieces of white pine 3/32 in. thick and ⅝ in. wide. Glue and lightly nail them to forecastle, poop and hull sides. The forward end may need steaming to twist it; have them a shade thick and when in position sandpaper to meet the rest of the hull.

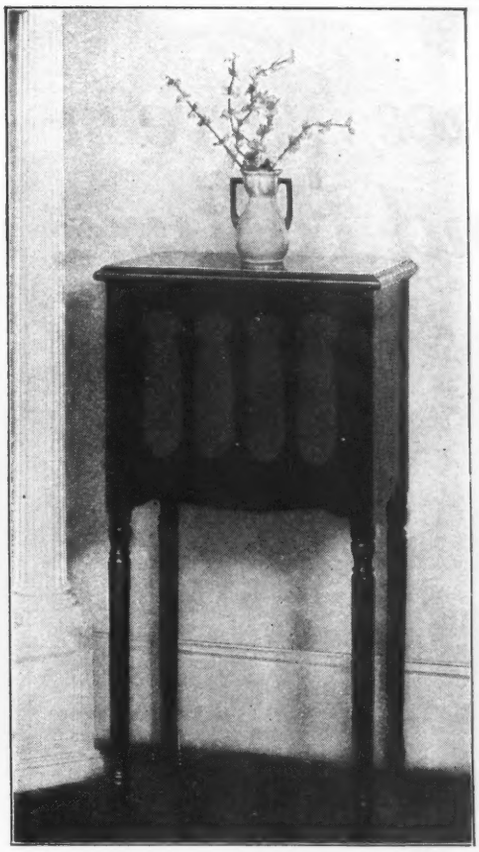
FROM a piece of pine ⅛ in. thick cut a horseshoe-shaped piece (I) to lie on the poop, which will continue the inside line of the bulwark. It had better project considerably on the outside and be shaved down to the hull lines after being glued. Make a similar piece (J) for the forecastle, which, inside and out, will have to continue the flare at the bow. These must be neatly joined to the bulwark pieces where they meet.

For the keel (K) cut a groove along the bottom of the hull 5/32 in. wide by 1/16 in. deep. Into this glue and nail a strip of pine 5/16 in. deep by the same width. Have it extend beyond the hull sufficiently to come under the stem and sternpost. If these are to be added, they come next; their shape will be seen in the sheer plan (Fig. 1).

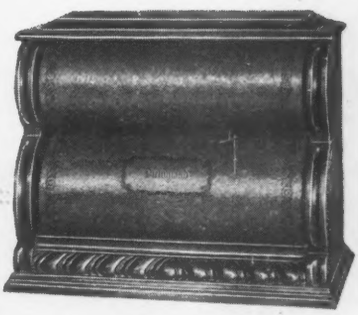
The two moldings (Fig. 3) come next. They can be (*Continued on page 86*)



THE STANDARD MODEL
Two-tone mahogany, hand-rubbed finish. $16.50



THE TABOURET MODEL $40.
Brown-finish mahogany . . .



THE DE LUXE MODEL
Solid walnut, handsomely carved. . . $25.

All prices slightly higher on the Pacific Coast and in Canada

Found: Radio's Lost Chords

Here, indeed, is a new speaker—new in principle, new in performance, new in artistic charm.

It is a speaker that finds, and delivers, the "lost chords" of radio.

It brings to you every instrument in the philharmonic orchestra, every voice in the augmented chorus, with every delicate shading of tone.

It was developed and perfected by acknowledged sound-scientists in the laboratories of Dictograph, famous in the realm of acoustics.

Of course, you may try it, with the compliments of your radio dealer.

The New DICTOGRAND ROLL SPEAKER

Made by the
DICTOGRAPH PRODUCTS CORP.
New York City

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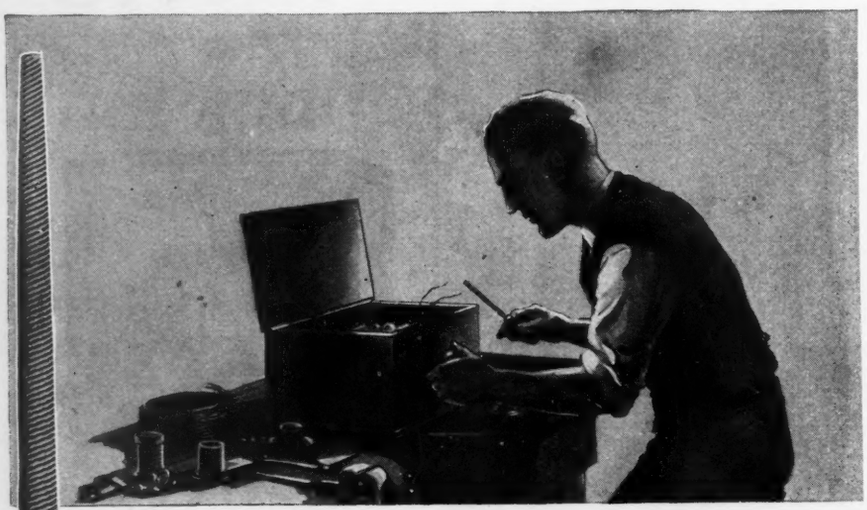
The difference between Success and Failure



Very Often Success or Failure is determined by a minute adjustment - a smoothing of the surface for Better Contact and Fit

Machinists and home tool users appreciate the NICHOLSON File for this work, because they can depend on its uniformity—its sharp, biting teeth that resist wear caused by constant usage.

Your local hardware dealer is well stocked with a complete assortment of NICHOLSON Files, and will help you select the right files.

NICHOLSON U.S.A. (TRADE MARK)

NICHOLSON FILE CO.
Providence, R. I., U. S. A.

—A File for Every Purpose!

The Home Workshop

A Beautiful Clipper Ship

(*Continued from page 84*)

made from wood, but hard cord, such as fishing line, is easier to handle and just as good. The lower one should be about 1/16 in. in diameter. Starting at the bow it follows the line of the main deck. Stretch and glue it along, helping to keep it in position with a few pin points. The top molding should be about half as thick, and be level with the edge of the bulwarks.

For the hawse pipes bore a 3/16-in. diameter hole, 1/4 in. deep in each bow, 3/4 in. abaft the stem and 1/4 in. below the lower molding. Point it toward the middle of the forecastle head. It is a round hole, but the angle at which it is bored gives it an oval entrance. Paint it red inside. Carefully bore a 1/4-in. hole for the bowsprit and then make the figurehead. Stick two pins in the stem, one for the head, the other for the extended arm. On these build up the figure with gesso (a thick paste of liquid glue and whiting with a little linseed oil and varnish) to represent a queen with flowing robes, one arm extended forward and the other backward along the hull. This figure might be carved from wood. If you do not wish to attempt the figure, just put a wooden curl under the bowsprit (called a billethead).

The figurehead should be white and gold and the scrollwork design should extend back to the hawse pipes.

A HANDRAIL (M, Fig. 4) will be wanted round the poop deck. This is most easily made from a piece of flat rattan cane, a scant 1/16 by 1/8 in. Measure off sufficient to go round, and at the middle and at 3/4 in. intervals drive 1/4 in. long points (from bank pins) through it. On these drop two or three beads, fastening them with a spot of glue, to make a rail fully 1/8 in. high. Invert this and drive the pin points into the edge of the bulwarks.

Make and fix the wooden catheads, (N, Fig. 4)—1/8 in. sq. and 1 in. long—and the bumpkins (O), which are 3/4 in. long. They should project through the rails.

The rudder is a slip of wood, thinned down toward the stern edge. It projects a little into the hull and is fastened on with pins or nails pointed at both ends.

Now draw the plank lines on the pieces H and G, if it has not been done previously, and give the entire deck a coat of thin varnish.

Scratch the water line where shown in Fig. 1 and give the hull a priming coat of flat white paint. When this is dry, sandpaper down and fill in any inequalities with white lead, or thick paint.

Sandpaper again; then give the upper part a coat of black, and the lower a coat of dark green or the color known as "light red," if you prefer. Rub this down and apply another coat, finally rubbing down with pumice stone and water to take off the extreme shine.

The top edges of the bulwarks are black along the waist and white at the forecastle and poop. The lower molding is white. The inside of the bulwarks is white, with (*Continued on page 88*)

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Constant Dependable B Power Direct from Your Light Socket is Now a Reality in Majestic Units

Give that set of yours the power it needs—power for any variation in tone. Then you'll have a new appreciation of radio. You will have one delightful program after another—summer evenings—winter evenings—*All the Time!*

That's when your set is equipped with Majestic "B" Current Supply. Your set seems *Alive* with marvelous energy. You sense a new joy in radio.

Reliable, unvarying power at an average cost of about one-tenth cent an hour! Economical, powerful—Lasts as long as any Receiver. Fully guaranteed.

Majestic "B" Current Supply

delivers pure direct current-From your light socket

You at last forget its mechanics, for a simple switch releases all the power you need for any program. Power—*clean—constant—abundant!* Power that instantly responds to high soprano, and as easily brings you the full resonance of an orchestration!

Their low purchase cost and the savings they bring to you make them an investment that soon is repaid. Don't delay—see your dealer at once or write for free literature.

DEALERS: If you are not yet equipped to get your share of the Majestic business, see your jobber or write direct giving us his name.

New York Show—Booth No. 10—Section "B"
Chicago Show—Booth No. 6—Section "F"

No Filament to Burn Out

All the Majestic "B" Current Supply units are manufactured complete in our factory and are equipped with the famous Raytheon tube (endorsed by numerous radio engineers and editors), which is a non-filament tube with full wave rectification, no acids or back surge. Tests of the Majestic "B" on the oscillograph demonstrate that all A-C hum is entirely eliminated.

Majestic Standard-B Current Supply

Especially adapted for sets having not more than seven 201-A tubes, or six 201-A plus one 135-150-volt power tube. Popularly priced for the average set. Improves tone—better reception.

Price.....$32.50
West of Rocky Mts..... 35.00

Majestic Super-B Current Supply

Capacity 1 to 12 tubes, including the use of 135-150-volt power tubes. Complete with switch to control current from light socket.

Price.....$35.00
West of Rocky Mts..... 37.50

Majestic Master-B Current Supply

Rating 60 mils at 150 volts. Particularly adapted for Radiola 25, 28 and 30 and superheterodynes. Will operate all power tubes, also the new super power tube UV-171 (180 volts). Unequalled for sets having a very heavy current draw.

Price.....$42.50
West of Rocky Mts..... 45.00

GRIGSBY-GRUNOW-HINDS CO.

4578 ARMITAGE AVENUE CHICAGO, ILL.

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Put Your Radio in STYLE!

G-33

$1.00

Aristocrat E-Z TOON
Vernier Pointer

$2.00

The NEW "Aristocrat" Vernier Port Dial

free!

This marvelous, recently compiled, 48-page Log Book (worth $1) is given FREE with every set of 3 Aristocrat Vernier Port Dials. Bound in beautiful, two-tone Mocotan Leather with embossed cover. Lists every United States and Canadian Radiocast Station of record June 1st, using power of 250 watts or more. Indexed by call letters, wavelengths and location. Also includes many of the principal foreign stations. Ample room for additional or local stations. Ask your dealer to show you a copy.

No matter how many tubes your receiver has, how much it cost or what its circuit principle is—your radio cannot be in style without vernier window dials. In radio, just as in fine motor cars, appearance and performance are constantly improved each season.

With the new Aristocrat Vernier Port Dials, your radio will appear just like the current model. And the Aristocrats will also make it perform like the new, advanced radios.

Vernier Ratio is 14 to 1. With this extremely fine tuning you can separate local stations of adjacent wavebands distinctly—and bring in countless stations you have never heard before right through powerful local broadcasting.

The Aristocrat is easily installed in but a few minutes. The famous Kurz-Kasch Split Bushing fits all condenser shafts—*aligns rite, holds tite!* All mechanism and shaft ends are concealed. No gears, chains or cogs to backlash, wear out or get out of order.

If you buy, build or operate a receiver with old-fashioned dials—or dials of doubtful quality—replace them with the up-to-date, beautiful Aristocrat Vernier Port Dials of pure Bakelite, bearing the KK Trademark.

In three rich finishes—to match your radio—black with white markings, mahogany and walnut with gold markings. The better dealers can supply you—at $2 each.

MEMBER R.M.A.

THE KURZ-KASCH COMPANY DAYTON, OHIO

Moulders of Plastics

KURZ KASCH

Aristocrat Dials and Knobs

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The Home Workshop

A Beautiful Clipper Ship

(*Continued from page 86*)

brown stripes to represent teakwood paneling.

While the paint is drying, one can be making the deck fittings (Fig. 3). The cabin house (P, Fig. 4) is a block of soft wood and sets into the poop deck. It projects ½ in. It should have a molding round the top edge and be white, with doors and windows painted on. The forward deck house (Q) is similar, only larger.

The hatches are blocks of wood, with a groove cut round them; the after one (R) has a slide opening, under which is supposedly a ladder leading to the hold. The companionway (T) on the poop is very similar, but white with painted doors at the after end. The skylight (U) also is a block of wood, with barred windows, recessed and painted, round the sides.

The binnacle (Y) is a similar block, paneled. These may have very thin cigar-box wood tops.

THE steering gear (W) is a block of wood set on pin-and-bead legs, right over the rudder trunk. The wheel can be a gear from an old watch, with every other tooth filed away, or can be cut from a thin sheet of celluloid or brass.

The bitts (X) are made from ⅛-in. sq. wood—two uprights set in the deck with a crossbar (bolster) recessed into them and stained brown. The after bitts are set across the inner ends of the bumpkins. The ladders can be fashioned from 1/16 by 1/32 in. cigar-box wood, or cut from celluloid. They lead, one on either side, from the main deck to the forecastle head and poop deck. Two or three steps are enough.

The fife rails (Z) around the masts are made from ⅛-in. uprights, with ⅛ by 1/16 in. horizontal pieces. The after ends of the one at the main are supported by pin-and-bead posts, and have three cut-off pins through them on either side, to represent belaying pins. The after ends of the forward fife rails are merely glued to the front of the deck house.

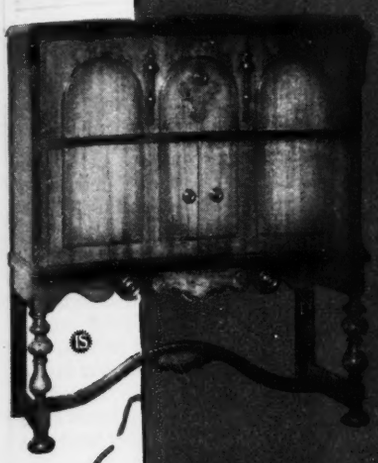
ON THE forecastle there will be a capstan (AA) fastened to the deck with a long pin. It may be painted green or black. There will be three posts for windlass bitts (FF), the larger and forward one ⅜ in. high and the others 3/16 in. high; these extend from the windlass underneath. There can also be a bell (KK) at the front edge.

On the top of the deck house there will be two boats (CC) glued and lashed to skids (crossbars), and the galley funnel (MM), painted black.

Staples, made by bending over stout pins, will be wanted in the positions indicated on the deck plan (Fig. 4). The two pairs amidship should be especially firmly placed. These can be more clearly seen in Blueprint No. 52.

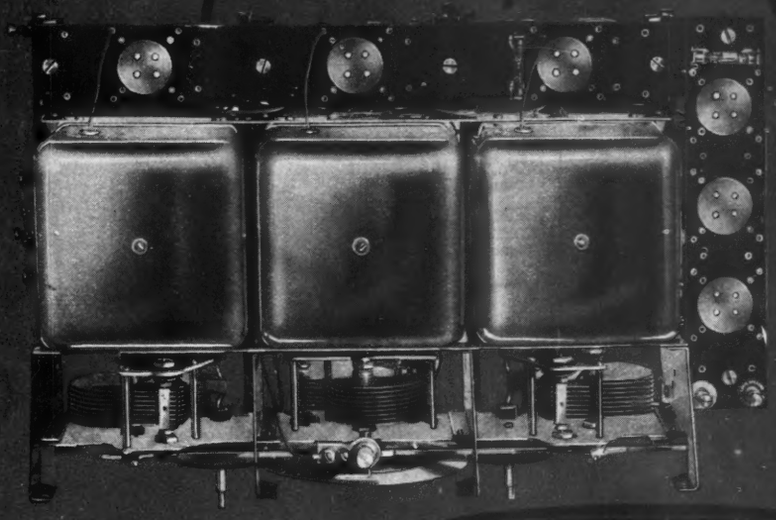
Next month Captain McCann will tell how to set up the masts and rigging and complete the model.

This Double Cell Shield 1926 greatest improvement



KING RADIO 63

Six tubes. Two stages radio frequency, detector, three stages audio. Fully shielded, completely double-shielded. In console cabinet of surpassing beauty, with Peerless Reproducer built-in. Price, $210. (Table model with same chassis, No. 62, $100.)



Every Stage Completely Double Shielded

1. This new King Double-Cell Shield is more than mere shield-partitioning. It is complete isolation from every other stage and from outside pick-up on the coils. Each cell is formed from a single piece of copper. Each is complete shielding for its stage. And when assembled, there is a double wall of copper between each coil. No radio we have ever seen, is so completely shielded. And none of similar capacity gives quite such clear reception and such great selectivity.

Single Dial Station Selector

2. Many receivers claim to operate on single dial. The King 62 and 63 pick up the station with a simple turn of a single knob—without sacrificing selectivity and volume. For distant stations, two verniers are available, one to increase or decrease volume, the other governing selectivity. Weak or distant stations are thus brought in with ease.

Cushioned Tube Mounting

3. Tube socket panels are mounted on flexible phosphor bronze springs that prevents the familiar "tube noises" caused by mechanical interaction.

Rugged Mechanical Construction

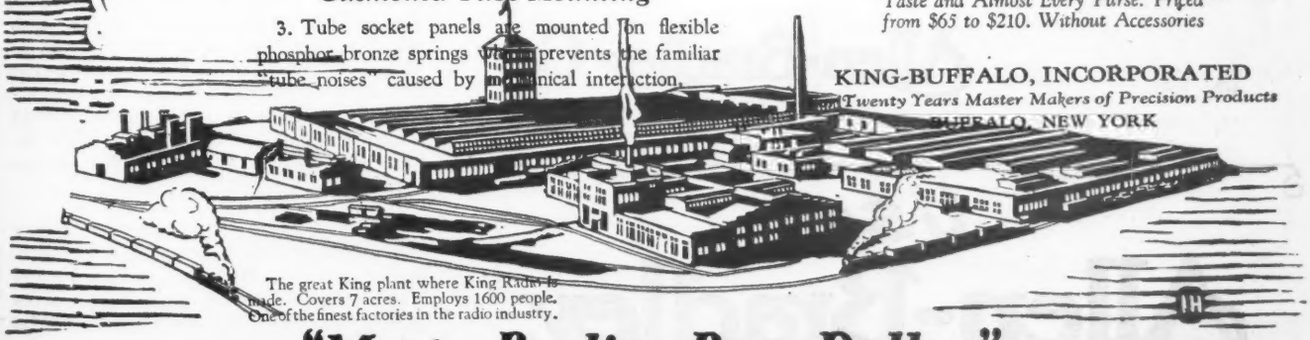
4. Four heavy brackets carry the construction. They are equally spaced and supported by heavy steel and brass strips. Durability is an inbuilt feature.

Pilot Light

5. A small lamp, drawing only one-tenth ampere is used as pilot lamp to illuminate the wave length scale. Beside making readings easy, this pilot light also serves to tell when tubes are on and off. Set may be operated without light.

There is a King Set for Every Radio Taste and Almost Every Purse. Priced from $65 to $210. Without Accessories

KING-BUFFALO, INCORPORATED
Twenty Years Master Makers of Precision Products
BUFFALO, NEW YORK



The great King plant where King Radio is made. Covers 7 acres. Employs 1600 people. One of the finest factories in the radio industry.

"Most Radio Per Dollar"

KING RADIO

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Bradleyohm-E
PERFECT VARIABLE RESISTOR
for B-Eliminators

Bradleyohm-E is a new and enlarged Bradleyohm designed especially for B-Eliminator Voltage Control. The extra long columns of scientifically-treated graphite discs insure perfect voltage control over a wide range. It is made in several ranges for various B-Eliminator circuits.

Bradleyunit-A
PERFECT FIXED RESISTOR

Bradleyunit-A is a solid molded resistor for radio circuits. It is molded and heat-treated under high pressure, making it impervious to moisture. The silver-capped ends can be soldered without affecting the calibration of the Bradleyunit.

Are You Building a B-Eliminator?

IF so, follow the example of leading radio engineers and use the Bradleyohm-E and Bradleyunit-A for your voltage control.

Most of the well-known factory built B-Eliminators are equipped with Bradleyohms as standard equipment. Surely, no better recommendation of the reliability and stability of the Bradleyohm can be asked.

Build permanent performance and high efficiency into your B-Eliminator by asking your dealer for Bradleyohm-E and Bradleyunit-A for your circuit.

Allen-Bradley Co.
293 Greenfield Ave., MILWAUKEE, WIS.

Use Allen-Bradley Perfect Radio Devices

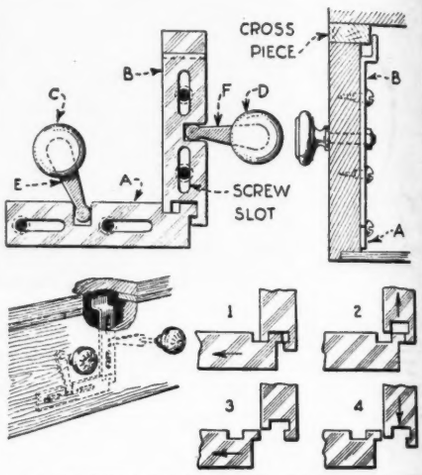
The Home Workshop

Curious Combination Lock Installed in a Bureau

By R. H. KASPER

AFTER purchasing an expensive bureau, I wished to attach a lock on one of the drawers without detracting from the appearance, but could not obtain one that would answer the purpose. I then decided to use a secret combination, using the original drawer knobs as dials to operate the lock. Although the arrangement is simple, it would puzzle any meddler or unauthorized person.

The knobs *C* and *D* carry on the inside of the drawer front the fingers *E* and *F*. Finger *E* engages a slot in the brass slide *A*, which is placed horizontally near the



In this secret lock two drawer knobs are used in combination to operate the bolt mechanism

bottom of the drawer front. Finger *F* engages a slot in the vertical slide *B*. Both slides are slotted in two places so that they can be retained loosely in position with wood screws.

Slide *B*, as shown in the sectional view, is offset to suit the width of the wooden crosspiece above the drawer. The offset portion acts as a lock bolt. In the position shown the drawer is locked.

To open, the knob *C* is turned to the right, as in No. 1, causing slide *A* to move a short distance to the left. Knob *D* then is turned to the right, causing slide *B* to move upward, as in No. 2. Knob *C* then is turned again to the right, which causes slide *A* to clear slide *B*, as in No. 3. Next, knob *D* is turned to the left, causing slide *B* to move in the direction of the arrow so that its upper end no longer engages the crosspiece. This unlocks the drawer. In locking, the process is reversed.

AMATEUR furniture makers often are puzzled as to how to finish the interior of drawers. Unless the natural wood is exceptionally dark in color, the drawers should be stained, but the stain should be considerably lighter than that for the outside of the case. The inside of the drawers then should be given a coat or two of flat drying varnish. The outside of the drawers and edges are finished best with a thin coat of shellac over the stain, as varnish may cause the parts to stick.

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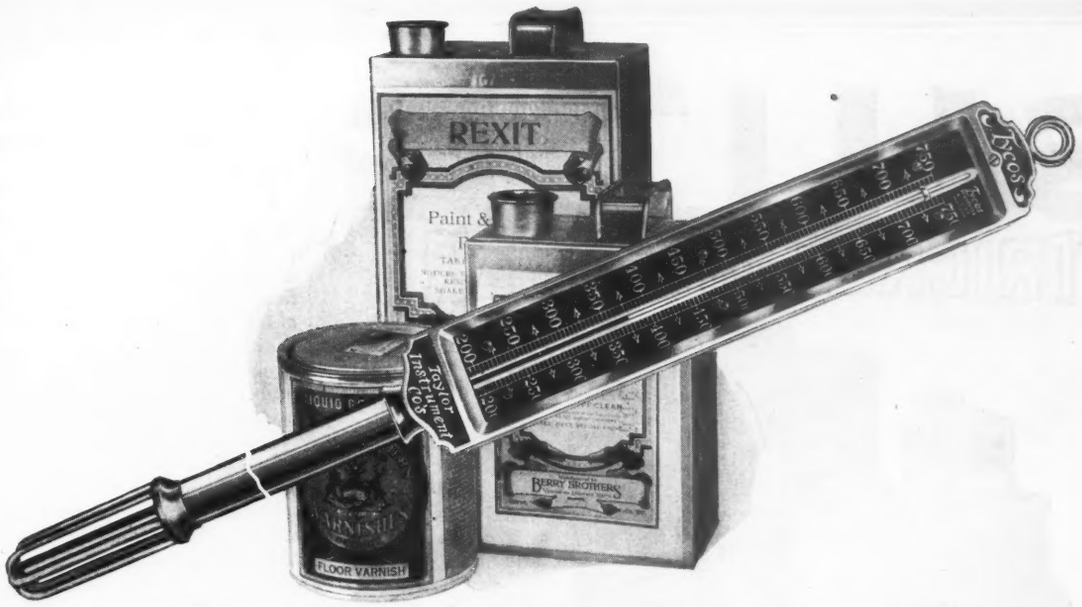


Tycos Instruments

have been used for 15 years in making BERRY BROTHERS Varnishes Enamels Stains Varnishes

Says E. G. Richardson, Chief Chemist of Berry Brothers

"The production of high-grade varnish such as our 'Liquid Granite' requires the use of the best materials, and also the exercise of the greatest care to see that each step in the various processes is properly followed.

"Temperature plays an extremely important part throughout. For instance, oil must be brought to a certain temperature and held there for a definite period. If the proper temperature is not reached, the oil will not have sufficient body. If it is exceeded, there is danger of fire.

"In cooking a kettle of varnish, the ingredients must be added at just the right moments and at the proper temperatures to insure perfect results. The spoiling of a kettle of varnish is a serious thing, for the materials we work with are expensive.

"The use of accurate and dependable temperature indicating devices is therefore an absolute necessity to safeguard the processes and put the responsibility squarely up to the individual workman.

"For 15 years we have used *Tycos* thermometers on our varnish kettles. These are hung over the sides of the kettles in which the varnish is cooked and give us correct temperature readings at all stages of the cooking.

"These instruments have always performed satisfactorily and we know we can depend on their accuracy. They not only prevent waste of very costly materials, but help us maintain the uniform high quality of our varnishes."

TO MANUFACTURERS

If your manufacturing processes require the indicating, recording or controlling of Temperature, there is a type and style of instruments in the *Tycos* Line of 8000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of *Tycos* to your particular manufacturing process.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. - - U. S. A.
Canadian Plant: Tycos BUILDING, TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

Tycos - for the Home

Tycos Office Thermometers
An aid in promoting human efficiency.

Tycos Bath Thermometers
To enable you to get the most good from your bath.

Taylor Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Taylor Quality Compasses
To show you the right way in unfamiliar country.

Tycos Fever Thermometers
A necessity in every home.

Tycos Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Tycos - for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on request.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

SILITE TRICKLE CHARGER

Absolutely Noiseless-
Makes a power unit of your storage battery!

You can make a power unit of your present storage battery with the new Silite Trickle Charger.

Absolutely noiseless, without bulbs or moving parts, Silite Trickle Charger is left permanently on charge. It replaces at a slow rate the power you use while your set is operating. Silite Trickle Charger may even be used while your set is in operation without hindering enjoyable reception.

No Bulbs—No Adjustments—Can't Wear Out!

Silite is the marvelous new metallic glass rectifying element discovered and perfected in the Kodel Laboratories. Silite Chargers have no adjustments, no wearing parts—they cannot overheat or damage your battery. Silite Trickle charges at .6 ampere—much faster than other trickle chargers—enough to keep a battery always at top efficiency. Your nearest radio dealer can show you the Silite Trickle Charger.

SILITE HOMCHARGER

Absolutely silent—fast 2½-3 ampere charging rate. No bulbs. Can be used while set is in operation. Complete, nothing else to buy . . **$19.50**

SILITE TRICKLE CHARGER

Makes a power unit of your battery. Left permanently on charge keeps a battery always at full efficiency. Absolutely silent—no bulbs. Complete **$10.00**

"Behind the Scenes in a Broadcasting Station", an interesting, 24-page booklet, together with literature describing Silite Battery Chargers, will be mailed free on request.

DEALERS: Write for full information on Silite Chargers and other Kodel Products.

THE KODEL RADIO CORPORATION, 500 EAST PEARL ST. CINCINNATI, O., U. S. A.

Owners and Operators of Broadcasting Station WKRC

Battery Chargers Power Units **KODEL** *Radio Receivers Loud Speakers*

POWER SPECIALISTS SINCE 1912

The Home Workshop

Latest Ship Model and Radio Blueprints

TWO notable additions are made to our list of blueprints this month. One is a set of three prints, Nos. 51, 52, and 53 in the list below, giving full size drawings of all the parts of a simplified model of the famous American clipper ship, *Sovereign of the Seas*. These blueprints supplement the article by Capt. E. Armitage McCann, which begins on page 65. If you intend to build this magnificent model, you will need all three blueprints.

The other addition is a set of two blueprints, Nos. 54 and 55, which show exactly how to build the incredibly efficient five-tube radio set designed by Alfred P. Lane and described in an article beginning on page 58.

Complete List of Blueprints

ANY ONE of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	*Title*	*Published*	*Price*
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	Mar., '22	25c
3.	End Table	Apr., '22	25c
5.	Kitchen Cabinet	May, '22	25c
8.	Shaving Cabinet	June, '22	25c
9.	Arbor, Gate and Seats	July, '22	25c
10.	Porch Swing	Aug., '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
12.	Electric Washer	Oct., '22	25c
13.	Tea Wagon	Nov., '22	25c
14.	Christmas Toys	Dec., '22	25c
15.	Workshop Bench	Jan., '23	25c
16.	Inlaid Radio Cabinet	Feb., '23	25c
17.	Cedar Chest	Mar., '23	25c
18.	Phone Table and Stool	Mar., '23	25c
19.	Grandfather's Clock	Apr., '23	25c
20.	Flat Top Desk	Apr., '23	25c
21.	Colonial Desk	Apr., '23	25c
22.	Cabinet and Desk	Apr., '23	25c
23.	Pergola Garage	May, '23	25c
24.	Gateleg Table	June, '23	25c
25.	Canoe Sailing Outfit	July, '23	25c
26.	Baby's Crib and Pen	Sept., '23	25c
27.	Kitchen-Cabinet Table	Oct., '23	25c
28.	Pullman Play Table	Nov., '23	25c
29.	Toy Tea Cart, etc.	Dec., '23	25c
30.	Tool Cabinet, etc.	Jan., '24	25c
31.	Sewing Cabinets	Feb., '24	25c
32.	Chinese Game Table	Mar., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
35.	Simple Radio Cabinet	Oct., '24	25c
36.	Rush-Bottom Chair	Nov., '24	25c
37.	Simplified Bookcase	Dec., '24	25c
38.	Sheraton Table	Jan., '25	25c
39.	Salem Chest	Feb., '25	25c
40.	Desk in Sheraton Style	Mar., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	June, '25	25c
43.	Four-Tube Receiver	July, '25	25c
44.	Pirate Ship Model—Hull	Feb., '26	25c
45.	Pirate Ship—Details	Mar., '26	25c
46.	Galleon Model—Hull	May, '26	25c
47.	Galleon Model—Details	May, '26	25c
48.	Sailing Yacht Model	July, '26	25c
49.	Broom Cabinet	Aug., '26	25c
50.	Airplane Model (Flying)	Sept., '26	25c
51.	Clipper Ship Model—Hull	Oct., '26	25c
52.	Clipper Model—Details	Oct., '26	25c
53.	Clipper Model—Rigging	Oct., '26	25c
54.	Five-Tube Radio Set	Oct., '26	25c
55.	Five-Tube Set—Details	Oct., '26	25c

Name.....
(Please print name and address very clearly)
Street.....
City and State.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

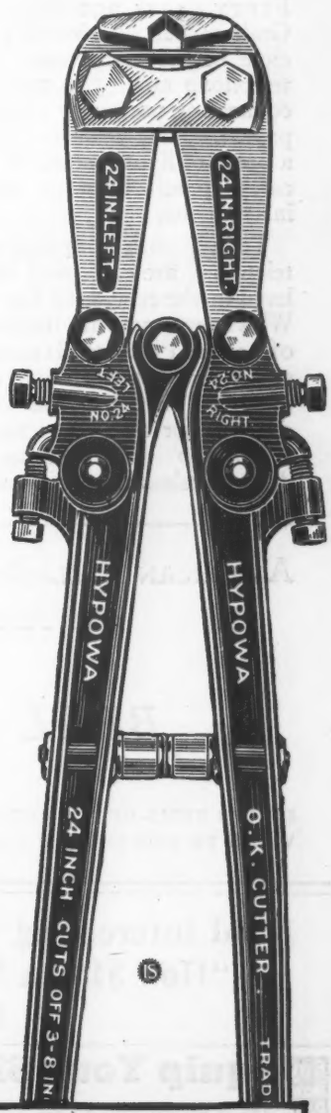
Two with the Strength of SEVENTY

Let those two hands grip the handles of a Porter Bolt Clipper and they have the power of seventy men,—power to cut heavy bolts, rods or chain; power to remove (by splitting), nuts which cannot be turned with a wrench; power to save valuable time; power to cut labor costs; power to make repairs quickly—anywhere.

Porter tools are used all over the world, in factories, in shops, on construction jobs, in mines—wherever labor saving is a factor.

Tools make the man—

Write for catalog of Porter Bolt Clippers, Wire Cutters, Chain Cutters and Nut Splitters. Order through jobber or supply house.



PORTER'S *Time Savers*

H.K. PORTER INC. EVERETT. MASS.

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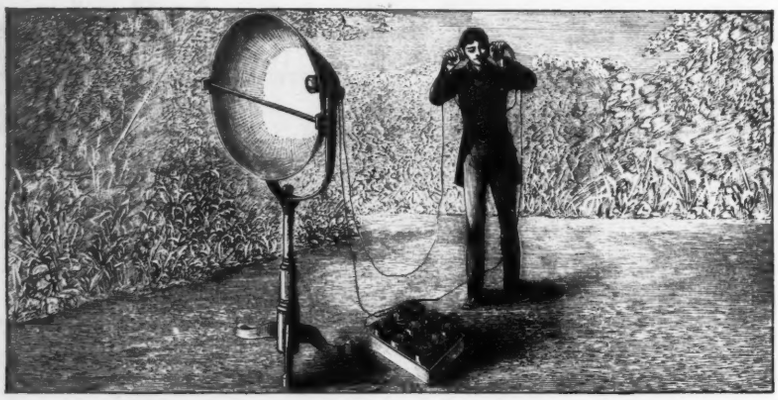
Telephoning over a ray of light



Building on the Telephone Principle

FIFTY years ago Alexander Graham Bell discovered the principle of the telephone. His first telephone employed wire as the connecting path over which words passed. Four years later he used a beam of light instead of wire to carry speech between telephone instruments.

Today, both wire and wireless telephony are employed on every hand in the service of the nation. Wire telephony, with its thousands of central offices, its complex switchboards and millions of miles of wire, envelops the country, carrying for the American people 70,000,000 conversations every day. Wireless telephony is broadcasting entertainment and carrying important information to the remotest regions.

But new applications of the telephone principle are still being found. In the loud speaker, in the deaf set, the electrical stethoscope, the improved phonograph, the telephone principle has been adapted by the Bell Telephone Laboratories to the uses of the physician, the public speaker and the musician. The scientific research and engineering skill, which enable America to lead the world in telephone service, are also bringing forth from the telephone principle other devices of great usefulness.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

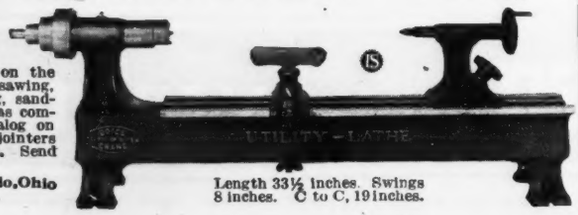
Read interesting article on Page 4, "How $100 a Month, Invested Properly, Can Make You Independent."

Equip Your Shop with Boice's "Utility"

Buy Now Pay Later

Let it pay for itself on our Easy-Pay Plan. Price considered, it has a bigger swing, longer bed, and more attachments for practical use than any other lathe on the market. Attachments for jig sawing, circular sawing, grinding, drilling, sanding, etc. Metal-working model has compound slide rest. Send for catalog on Boice Crane circular saws, band saws, jointers and drills. Attachable to light socket. Send today—NOW!

W.B.& J.E.BOICE Dept.P.S.10-B.Toledo,Ohio



Length 33½ inches. Swings 8 inches. C to C, 19 inches.

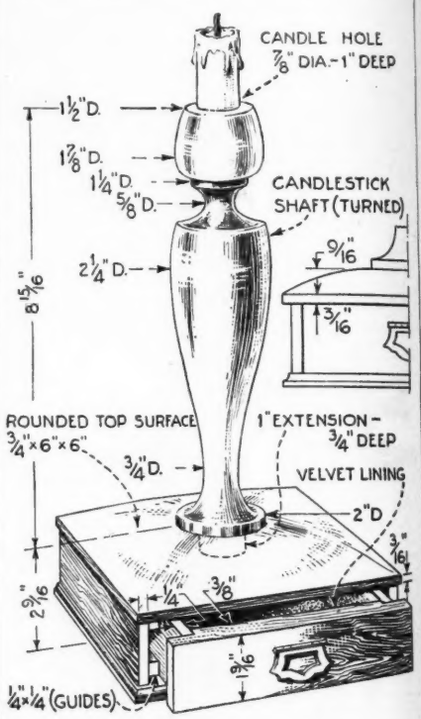
The Home Workshop

Unique Candlestick Has Drawer for Jewels in Base

BY ADDING a small drawer to the base of a candlestick, a novel and attractive ornament can be made.

Figured mahogany or walnut is an excellent wood to use if a stain and varnish finish is desired, but soft wood is suitable if the piece is to be polychromed. If the builder does not wish to make the candlestick himself, he can purchase one from an art store, and substitute for its base the little cabinet shown.

For the top of the base, cut a 6 in. square from 1 in. thick stock, and round off the upper surface except at the center



The base supporting the turned candlestick is a small cabinet with a drawer for jewelry

where the candlestick shaft will stand. Cut a mortise to receive the shaft's tenon.

The bottom is of ¼ in. stock, 6⅛ in. square. Gage pencil lines through the center of the edges, and also on the upper side 1/16 in. from the edges. Chamfer the stock to these lines and hollow out a shallow cove with a small gouge (or penknife) and sandpaper.

On the under side of the top and the upper side of the bottom gage pencil lines 5/16 in. from the edges. Guiding by these lines, glue ¼ by ¼ in. hardwood strips across the sides and back, keeping the front ends of the side strips back 5/16 in. to act as drawer stops. When the glue has dried, reinforce with ½ in. brads driven every 1½ in.

For the sides, make two rectangles of ¼ in. stock, 1 9/16 by 5½ in., and rabbet the inner faces of the back ends ¼ in. wide and 3/16 in. (*Continued on page 96*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

The Passing of "By-Pass" condensers

Dubilier Condenser Type 907 Capacities 0.1 to 2.0 mfds. Price $.60 to $1.75

"BY-PASS" was the name originally given to small paper condensers by Dubilier. This name described their functions—such as shunting radio frequency currents around high resistances, and their use in amplifier circuits.

But now the clumsy old "By-Pass" condenser is out of date. The high voltage used in radio today along with sub-panel construction, demand a condenser of higher electrical efficiency and more compact size.

In the new Type 907, Dubilier has made a compact all-purpose condenser with a *working voltage** of 160 volts D.C. With improved soldering lug terminals and mounting feet, Type 907 will give more efficient service in smaller space for every purpose for which the old "By-Pass" type of condenser has been used.

For long life at high voltages insist on Dubilier Paper Condensers.

Dubilier

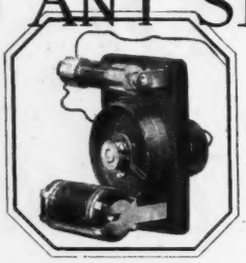
CONDENSER AND RADIO CORPORATION

*Working voltage means more than "test-voltage." It is the voltage at which a condenser may be safely used in continuous operation

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

CRYSTAL CLEAR TONES ON ANY SET

IN U. S. A.
$3.50



Dealers or Direct

Carborundum Stabilizing Detector Unit
Reg. U.S.Pat.Off.

THERE is no denying the pure true quality of crystal reception.

And you can get such reception on any set without the fuss and worry of a nervous Cat's whisker jumping off the sensitive spot.

The Carborundum Stabilizing Detector Unit has revolutionized crystal detection. Built around the Fixed Permanent Carborundum Detector—no Cat's whisker—no adjustments—retains its sensitivity and simply can not burn out.

The Stabilizer gives you a resistance controlling feature through which the Detector can be made to match the impedance of any circuit. Simply turn the potentiometer knob.

The addition of an ordinary flash light dry cell gives the necessary booster voltage.

For greater sensitivity—greater distance—but above all for the reception of tones of natural quality equip your set with

The Carborundum Stabilizing Detector Unit
It improves any set

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.

SALES OFFICES AND WAREHOUSES IN
New York · Chicago · Boston · Philadelphia · Cleveland
Detroit · Cincinnati · Pittsburgh
Milwaukee · Grand Rapids

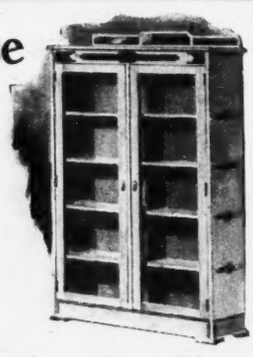
Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

The Carborundum Company
Niagara Falls, N.Y.

Please send free Hook-Up Book D-6.

Name_____
Street_____
City_____ State_____

An *Easy-to-build* Bookcase



IF YOU have not had much experience in woodwork, you will find the bookcase illustrated one of the few really attractive and useful pieces of furniture that you can construct without a single difficult joint. The parts are put together with butt joints such as are used in making common boxes; there is not a dowel, a mortise and tenon, nor a dovetail used in the construction.

The unique methods by which the construction has been simplified are not apparent, however, in the finished bookcase. The design is good and will stand comparison with the better class of bookcases sold in furniture stores.

Blueprint (No. 37) of the bookcase will be sent on receipt of 25c.

POPULAR SCIENCE MONTHLY, 250 Fourth Ave., NEW YORK

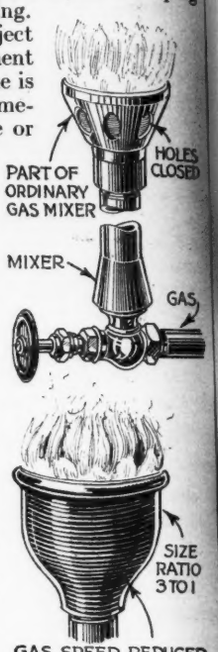
The Home Workshop

How to Improve a Common Workshop Gas Burner

ONE of the greatest faults of the home constructed gas furnaces so often used for brazing, melting and heat treating is the difficulty experienced in keeping the appliance burning. As soon as the object undergoing treatment is removed, the flame is blown out almost immediately by the force or speed of the gas.

In most of these furnaces the bunsen tube is merely a straight piece of pipe. By screwing or otherwise attaching a reducer to the burner end of the bunsen tube, a perfect high pressure blast will result. It will not blow out.

Any bunsen burner thus equipped (either with a part of an ordinary mixer or a common reducer) may be used successfully in any position as a portable blowtorch.—JOHN H. SCHALEK.



Two ways of altering a workshop gas burner

Unique Candlestick

(*Continued from page 94*)

deep. The back piece is 1 1/16 by 5 3/16 in.

Size all the end grain of joints with a thin coat of liquid glue. When dry, scrape off any lumps, apply glue to the joint parts, and assemble the sides and back with top and bottom. In clamping together, be sure that the assembly is square at every joint.

Make the drawer front 3/8 by 1 1/16 by 5 3/8 in. In the lower edge cut a rabbet 3/16 in. deep and wide, to receive the front edge of the bottom. Lastly, rabbet the ends 3/16 in. deep and 1/2 in. wide, to carry the ends of the drawer sides. These are of 1/4-in. stock, the same width as the front, and 5 5/16 in. long. Rabbet the lower edges 1/8 in. wide and 3/16 in. deep, and the back ends 1/4 in. wide and 1/8 in. deep. The drawer back is 1/4 by 1 3/8 by 5 3/16 in.

Size the end grain of the joints, and glue them when assembling. Nail the front ends of the sides and the ends of the back with 1/2-in. brads, and nail in the 3/16-in. bottom, which extends under the back.

When the finish is dry, add a neat drawer pull, and line the drawer with velvet.

If the candlestick shaft is to be turned, use 3-in. square stock cut 10 1/2 in. long. If no lathe is available, a good looking shaft can be made with a square section, the four sides being shaped by saw kirfing to the necessary depth and trimming with chisel, spokeshave and wood rasp.—E. L.

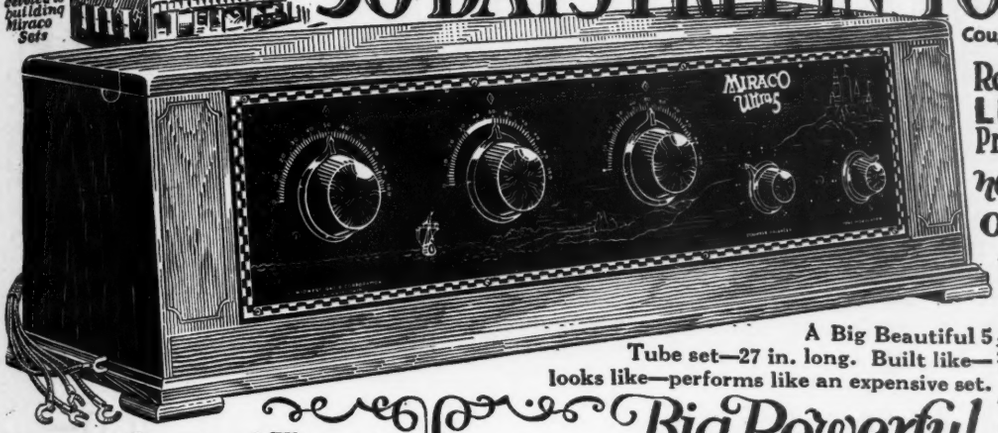
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

7th Successful Year!

Every inch of this big 4-story factory is devoted to building Miraco Sets

America's foremost direct-selling radio set factory invites you to enjoy the Ultra-selectivity, Tremendous distance range, clear tone and great volume of a Big Powerful latest model Miraco!

30 DAYS FREE IN YOUR HOME



Coupon Brings Amazing Special Offer!

Retail $ LIST Price 40.75 now only GET SPECIAL OFFER one year GUARANTEE

Tested and approved by all of Radio's Highest Authorities

A Big Beautiful 5 Tube set—27 in. long. Built like—looks like—performs like an expensive set.

Coast to Coast and Foreign Reception Certified by Miraco users!

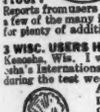
MIRACO RADIO GETS 'EM COAST to COAST

Send for Proof!

NOTICE! Enormous sales of the celebrated Miraco 5-tube Receivers (resulting from delighted users so highly endorsing them to friends) again enable us to add hosts of cost-lyrnew features, latest refinements and up-to-the-minute improvements such as you might expect to find only on much higher priced sets. Miraco's this year are still better—more beautiful—more selective—more powerful—for less money than ever before!

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

3 WISC. USERS HEARD FRANCE Kenosha, Wis. I was one of Kenosha's International Test Listeners during the test week Jan 24 to 30. Am sending a clipping of the Kenosha Eve. News to prove I had PTT Toulouse, France. On Thursday night I picked up LOX at Argentine. Both verified by Kenosha Eve. News as having some of the program. We have sold a number of Ultra-5's, and two of the sets reported having PTT also. Horace R. Boylan.



OREGON HEARS FLORIDA—MEXICO. Antelope, Ore. Comparison with higher priced radio sets has proved the Miraco everything you claimed for it. I have had about 100 stations from Florida to New York and from Mexico City to Canada, all on the loudspeaker. Vernon Hill.

THRU LOCAL COAST TO COAST Cleveland, O. Located about 1 1-2 miles from WTAM, I can tune them out on 3 degrees of the dials. I have gotten: 9 New York stations; 14 Chicago stations; Mexico City; Los Angeles; Denver; Cuba and Miami, Fla. all with good loudspeaker volume. Geo. S. Montgomery.

ILL. HEARS LONDON—LOS ANGELES. Danville, Ill. List enclosed of stations logged this week on Miraco Ultra-5. Received several foreign stations on loudspeaker. 2LO London was heard plainly. I had Cuba and Mexico City several times. Also logged KFI, Los Angeles. Earl Everett.

THRU CHICAGO LOCALS—COAST TO COAST. Chicago, Ill. Some of the stations I get on Ultra-5 with all Chic. stations broadcasting: KFAE Pullman, Wash.; WEAF New York; KFAL Denver, Colo.; KFI Los Angeles, Cal.; KFKX Hastings, Neb.; KOA Denver, Colo., 6WK Tuinucu, Cuba, WBAP Ft. Forth, Tex.; WSI Charlotte, N.C.; WCAP Wash. D.C.; WGY Schnectady, N.Y.; WJZN. Y. WJAX Jacksonville, Fla. A. Huff.

EQUALS HIGH PRICED SETS. Pittsburgh, Pa. I am getting the very best results in Radio Reception that can be found in any high priced super set or any costing 5 times the price of my Miraco Ultra-5. Friday evening 11:15 P. M., Madrid, Spain, entertainment was clear. I tune them in on the loudspeaker, coast to coast and then some more. If there is anything on the air the Miraco will bring it home. J. H. Adamson.

N.Y. HEARS LOS ANGELES. Glenfield, N. Y. Have logged 93 stations in 8 weeks on our Miraco Set all on the loudspeaker including stations in Canada, Florida, Cuba, and Los Angeles. Mrs. LeRoy Burdick.

COLORADO "TOURS CONTINENT." Jaroso, Colo. It is really wonderful what your Miraco Ultra-5 can do. I have gotten Seattle, San Francisco, Los Angeles, Phoenix, Ariz., San Antonio, New Orleans, Miami, Florida, and Atlantic City and New York City and CKY in Canada. Now I'll say that is touring the continent. Stewart L. Medill.

NEBR. HEARS N. Y. TO CALIF. Geneva, Nebr. Having fine success with your 5 tube set. Have picked up stations as far away as WSB Atlanta, Ga.; WEAF New York; WSMB New Orleans; WFAA Dallas, Tex.; WGO Oakland, Cal. R. D. Hampton.

BEATS OTHERS IN TESTS. West Salem, O. Have demonstrated Miraco beside a good many different sets and not one of them was as good. During International Radio Week Jan. 27th, at 11:28 P. M. EAJ Madrid, Spain was heard plain At 11:40 an announcement was made from Hamburg, Germany, also heard CGZ Mexico City and WKAQ Porto Rico. Have 75 other distant stations on my log including KFI Los Angeles, Cal. KGO Oakland, Cal. 6KW Tunicuco, Cuba Howard Snoddy.

COAST TO COAST ON SPEAKER Claude, Tex. Very much pleased with my Miraco. I have gotten stations all over the United States with it. Received New York and within a few minutes I had brought in Los Angeles on loudspeaker. That is truly "coast to coast" reception. L. Wiegman.

PERFORMS LIKE $175, $200 SETS. Ringgold, Va. To say that my Miraco is a "wonder" is a small expression. Friends say that it is as clear and plain as sets that cost $175 and $200. Have heard WDAF Kansas City, Mo.; WABI Bangor, Me.; WPG Atlantic City, N. J.; KFJF Okla. City; KFI Los Angeles, Cal.; WEAF New York, N. Y. Berry Beasley.

ALA. CUTS THROUGH LOCALS Camp Hill, Ala. My Ultra-5 is doing fine. Can get most any station I want from Mexico to Mass. From Cuba to Canada with all of our local stations going full blast. R. C. Whetstone.

VIRGINIA HEARS CALIFORNIA Mt. Sterling, Va. Miraco Ultra-5 sure gets them. It's as easy to operate as a Ford. I have over 92 stations to my record. Programs come in on the speaker from Ottawa, Canada, Ont. and Montreal, Que. to Havana and Tuinucu, Cuba, also Mexico City and from New York to Los Angeles, Calif. E. H. Baker.

CAL. FINDS MIRACO EXCELS Suisun, Cal. Am ordering another Ultra-5, the set sure does all you claim. I have tried it out with many other sets costing twice or three times as much only to find the Ultra-5 as good or better in most cases. Earl Branscombe.

SELECTIVITY! CUTS THRU LOCALS. Detroit, Mich. I am satisfied with Miraco. Can cut thru WWJ WCX WJR WGHP very very strong local stations. Charles Paul.

Send coupon for Amazing Special Offer!

Big Powerful New MIRACO

TRADE MARK REGISTERED

Ultra 5

Guaranteed by a Big Old Company 7th Successful Year

Sloping Front Cabinet-Panel-Dials Finished in Walnut

[ULTRA-SELECTIVE LONG DISTANCE SET EASY ON BATTERIES]

Unless convinced—after a good long trial in your home—that the beautiful new high-powered Miraco is the most astonishing bargain offered in big, fine, high-grade radios, don't buy it. Could any offer be fairer? And, remember, this offer is made by a large responsible manufacturing corporation—one of the oldest and most successful set-builders in the industry—a concern which has grown to immense size through the recommendations of satisfied customers who bought after trial.

Testimony of delighted users from coast to coast offers positive proof that the big Miraco actually is unmatched (even at much higher prices) for "razor-edge" selectivity combined with extreme long distance reception, clear natural tone, powerful loud speaker volume and economy in use of battery current.

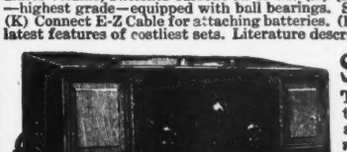
It comes completely built, thoroughly tested and factory guaranteed for one year. A big, beautiful expensive looking radio,—one you'll be proud to have friends see and hear. Has stylish sloping front cabinet, handsomely gold illustrated genuine Bakelite front panel and large Bakelite knobs with "arrow point" indicators for fine tuning—in beautiful walnut finish throughout.

Clip coupon now for literature and Special Offer that will surprise and interest you.

Compare its construction with highest priced sets—study this picture

Rear View of Celebrated Ultra-5

Note the neat sturdy high-class construction; wide spacings between parts eliminate losses and interference. All wiring concealed under genuine Bakelite base panel (M). Flexible wiring prevents broken or noisy connections. Flush-type sockets for the new tubes. (A) (B) (C)—"Duoformers"—famous exclusive Miraco Ultra low loss, self shielded and matched coils—one of the Miraco secrets of selectivity with powerful volume on long distance stations. (D) "Counter Balancer"—patented feature, NOT a rheostat or potentiometer. Controls oscillations on all wave lengths, reduces "B" battery consumption and further increases selectivity, distance range, clarity, power and volume. (E) (F) Shielded transformers of famous make evenly amplify all notes; beautiful tone quality. (G) Tone Modulator—regulates volume, switches current off or on. (H) (I) (J) Low Loss Straight Line Frequency Condensers—highest grade—equipped with ball bearings. Solid brass plates. Evenly separate all stations. (K) Connect E-Z Cable for attaching batteries. (L) Genuine Bakelite front panel. And many other latest features of costliest sets. Literature describes them fully, send for it!



Single Dial Control!

The celebrated Miraco Ultra-5—U. S. Navy type circuit, above described, has also been adapted to Single Dial Tuning—*without sacrifice of selectivity, volume, clearness, power, tone or distance getting qualities!* In the magnificent big Miraco Unitune-5, here shown, you turn one vernier knob for stations everywhere. Literature describes this great achievement. *Also offered on 30 days free trial!*

AGENTS! DEALERS! Write for our latest Miraco proposition. Nation-wide popularity, superior performance of Miraco 5-tube sets, at amazingly lower prices, make them easy to sell. Send coupon today for proof

All the Proof you want is waiting for You!

Coupon or postal brings reports from hosts of users in your vicinity and elsewhere proving that Miraco sets at rock-bottom money-saving factory prices, outperform sets costing up to four times as much. You can also buy speakers, tubes, batteries, etc. at big savings from us! Get our proposition before spending money elsewhere.

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
Cincinnati, O.

408-D Miraco Building

Without obligation, send free literature, testimony of users, AMAZING SPECIAL OFFER and full particulars of your **big money-saving factory-price proposition** on Guaranteed Miraco sets and all radio supplies. ( ) Agent ( ) User ( ) Dealer

NAME

ADDRESS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

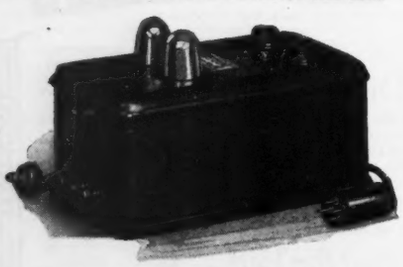
Makes Radio a Musical Instrument

AERO B

Every note of every instrument ~ clear as a bell

That is what an Aero B Amplipower will do for *your* radio set. You will actually hear the deep resonant bass that is essential to *real music*—notes that have been "starved" in radio reception.

With an Aero B Amplipower, the tone of your set will be as much better as the tone quality of the new talking machine is better than that of the old.



The Amplipower supplies *all* the "B" current for the set, eliminating "B" batteries, and, in addition, has the built-in high voltage power tube that increases volume and improves the tone quality. Can be attached to any set in a few minutes in the same manner as "B" batteries without changes in wiring. Price $65.00 without tubes.

Aero B is also built as a "B" power unit without the high voltage power tube. Price $50.00 complete.

THE GLENN L. MARTIN COMPANY
Radio Division Cleveland, Ohio

The Home Workshop

A Sand Table to Keep the Children Happy

YOUNG children get more lasting enjoyment out of playing in a pile of sand than in almost any other activity. A sand table, such as the one illustrated, gives them a chance to amuse themselves in this way to their heart's content. This table is particularly strong and neat, yet so simple that the home mechanic should have no trouble in making it. The addition of a hinged top makes the table, when closed, useful for other purposes.

First glue up stock for the top leaves (Figs. 1 and 8 on the following page) and for the bottom. Cut two pieces of 1 by 12 in. pine 4 ft. 1 in. long for the top and plane the edges straight. As 12 in. stock is always a trifle narrower than 12 in., glue and nail to one edge of each a strip sufficiently wide to give a finished width to the boards of 12 in. Smooth the joints flush and sandpaper enough to work the dust into the glue, hiding the joint.

Glue up the bottom, using three widths of 1 by 8 in. pine, and finishing the width

When the children are through playing, the top is closed and the table put to other uses

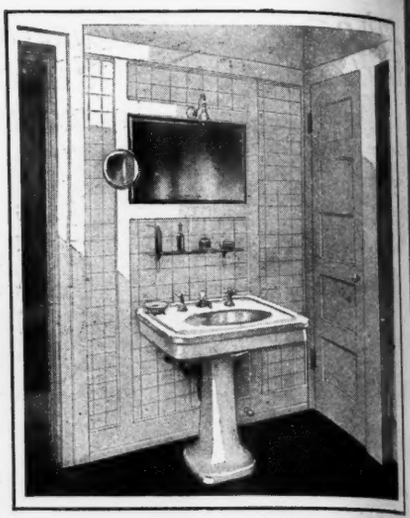
with a narrow strip glued and nailed. Drive three ⅝-in. corrugated fasteners into each joint from the underside, and set the piece aside to dry.

Cut the 2 ft. 2 in. legs from 3 by 3 in. stock, and square them to a net width of 2½ in. Choose the two best sides to go outside, and mark the others with an X to use as face or working sides. Measure down from the upper end of one leg 7½ in. and square around the stick, holding the square handle against the face sides. Gage a line on each outside face 1¾ in. from the opposite working face, and rip down, sawing in the waste wood. Cut off the ¾-in. blocks so formed, making the tenon shown in Fig. 2.

Lay out ¾ in. below the shoulder on each working side for a mortise ¾ in. wide and 1¾-in. long, centering on the side. Cut these mortises to a depth of 1¾ in. by chiseling across the grain with a ¾-in. chisel, or by boring holes and then trimming smooth.

Lay off the other three legs with the first as a pattern, being careful to make the set in two pairs.

For the rails, (*Continued on page 100*)



A tiled bath or kitchen—

at about 1/10th the cost

GLISTENING white! Waterproofed! Easily cleaned!

Now every home can afford a snow-white, sanitary bathroom or kitchen.

Use Upson Fibre-Tile. Apply the big, room-length panels right over the old wainscoting or direct to the old plaster. Properly applied, they should never warp or bulge.

Then enamel the surface, cover the joints with wood trim, and your bath or kitchen has the porcelain-like finish of expensive ceramic tile, at a cost within your reach.

Do not confuse Upson Fibre-Tile with other tile boards. Its tile indentations are *permanent*. And because the surface is smooth, not fuzzy like substitutes, Upson Fibre-Tile saves one or more coats of enamel. Comes in two patterns—square or oblong.

Try Upson Fibre-Tile on your kitchen or bathroom. Its record shows it a proved success in thousands of buildings. You'll like it. We invite you to write for samples and blue prints.

UPSON PROCESSED BOARD

Identify genuine Upson Fibre-Tile by the Blue Center in panel edges.

THE UPSON COMPANY
1027 Upson Pt., Lockport, N.Y.

Enclosed find ten cents for finished samples of Upson Board and Upson Fibre-Tile, and for blue print for .....
(kind of room)

NAME .....

ADDRESS .....

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS.

"They last twice as long as the smaller Batteries of equal voltage"

"THAT's a pretty broad statement, Tom. Won't you have to make it conditional on the number of tubes in the set or the use of the new power tubes?"

"No, sir! Under the same operating conditions—whether you use four, five tubes or more, whether you use a power tube that uses up to 135 volts, the Eveready Heavy-Duty No. 770 or the even longer-lived Eveready Layerbilt No. 486 will last twice as long as the smaller sized 45-volt batteries."

"Well, they ought to, they cost more."

"Yes, about a third more—but lasting twice as long, they cost much less."

"Your arithmetic is good, Tom, but if that's so, when I bought my set why did the dealer equip it with the smaller Eveready 772's? Why didn't he put in the Eveready Heavy-Duty Batteries?"

"He probably thought he was doing you a favor—making your first investment cost you a little less. That little difference looks like a lot to a good many folks who are buying their first set, equipped with tubes, loud speaker, 'A' and 'B' batteries and everything."

Heavy-Duty batteries last twice as long as the smaller batteries of equal voltage. Eveready Heavy-Duty Batteries are the great contribution that the world's foremost electro-chemical laboratories has made in "B" battery economy, dependability and satisfaction.

Dry "B" batteries give a noiseless current, pure D. C. (direct current), the kind that is essential if you prize pure tone.

Send for booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request. This booklet also tells about the proper battery equipment for use with the new power tubes. There's an Eveready dealer nearby.

Manufactured and guaranteed by

NATIONAL CARBON CO., INC.
New York San Francisco

Canadian National Carbon Co., Limited
Toronto, Ontario

NOTE: A "C" battery gives a quality of reception unobtainable without it and greatly increases the life of your "B" batteries.

LEFT - *Eveready Layerbilt No. 486.*

RIGHT - *Eveready Dry Cell Radio "A" Battery, 1½ volts.*

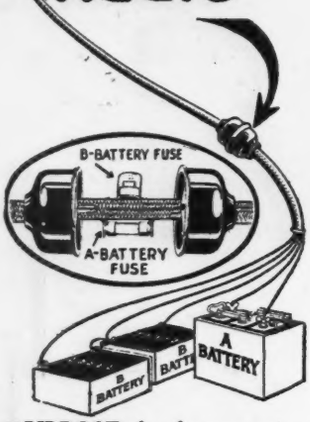
EVEREADY
Radio Batteries
-they last longer

Tuesday night means Eveready Hour — 9 P. M., Eastern Standard Time, through stations:

WEAF–*New York*	WSAI–*Cincinnati*
WJAR–*Providence*	WTAM–*Cleveland*
WEEI–*Boston*	WWJ–*Detroit*
WTAG–*Worcester*	WGN–*Chicago*
WFI–*Philadelphia*	WOC–*Davenport*
WGR–*Buffalo*	WCCO–*Minneapolis, St. Paul*
WCAE–*Pittsburgh*	KSD–*St. Louis*

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

A Safety Valve for Your Radio



SUPPOSE the battery wires to your radio set became crossed, accidentally, what would happen? Almost anything from a serious fire, due to overheated wires, to a ruined B-battery or a burned-out tube. The consequences are serious enough to warrant some careful thought, right now!

The cheapest insurance against the dangers of crossed wires is to protect your radio set with a Belden Fused Radio Battery Cord. It provides

1—An A-battery fuse.
2—A B-battery fuse.
3—A polished bakelite cover for the battery fuses.
4—A compact connecting cable that dispenses with loose wires.
5—A color-code on each wire for identifying each circuit.
6—A time-saver, because the cord is quickly connected and easily concealed.

Eliminate fire hazard, ruined or discharged batteries, and burned-out tubes. Ask your nearest dealer for a Belden Fused Radio Battery Cord, to-day!

Belden Manufacturing Company
2304A S. Western Avenue, Chicago, Ill.

Use a Belden Fused Radio Battery Cord ®

The Home Workshop

A Sand Table

(Continued from page 98)

smooth up and plane to a width of 2½ in. two pieces of 1 by 3 in. stock, 3 ft. 10½ in. long (Fig. 9), and two pieces 1 ft. 10½ in. long (Fig. 3). Miter and notch as shown

In the center of the long rails (Fig. 9), cut dadoes ¾ in. wide and ¼ in. deep to receive the ends of the center rail, which is 1 ft. 9½ in. long. See Figs. 1 and 4.

Assemble the rails and the legs, applying the glue to both tenons and mortises and clamp them together. The outside size should be 2 by 4 ft. Square up and set aside to dry.

Square up the bottom (Fig. 5) and notch each corner. Slip it into place be-

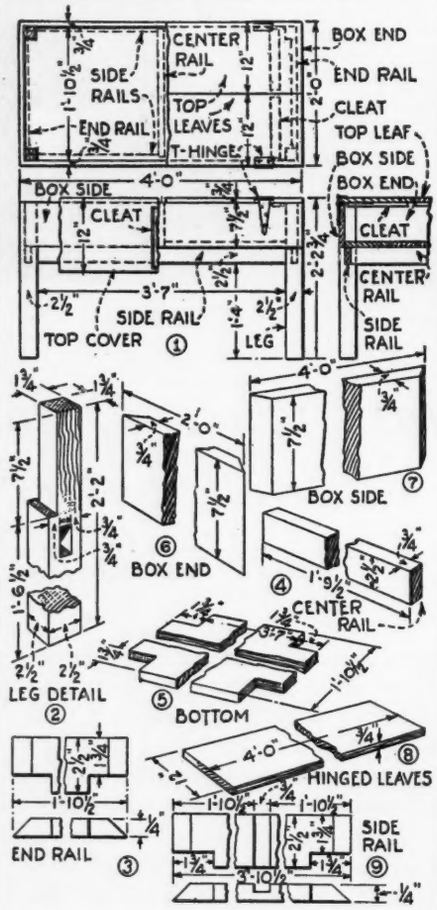


Fig. 1 shows the top, front and part of the end view; Figs. 2 to 9 give the working details

tween the legs, so that it rests on the rails, and nail through the face into the edges with sixpenny finishing nails.

Now make the box sides and ends (Figs. 6 and 7) of 1 by 8 in. stock. Miter and fit around the leg notches and nail to the legs and bottom with sixpenny finishing nails. Nail the miters with fourpenny finishing nails.

Attach the top boards to the side rails with steel T-hinges, notching the wide sides into the top pieces. To prevent the top from warping, screw three cleats 11 in. long to each top board.

The table may be finished to match the woodwork of the room, or simply oiled with boiled linseed oil. Half fill the box with sand.—EDWIN M. LOVE.

The One Time Machines Behave

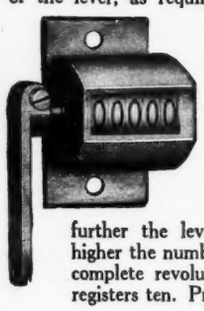
What machine is so well designed that it always behaves without watching?

The nearest approach to such a machine is the one equipped with a Counter. The moment there's any "acting up," it *shows* on the record of the Counter.

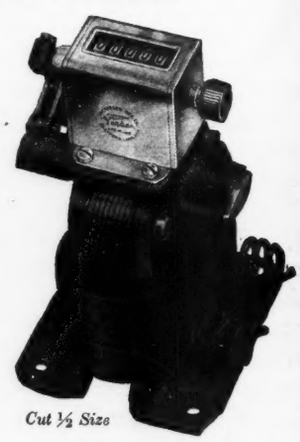
Without standing over the job yourself, you can make the best-time record of output the *ALL*-time record—with the aid of a

Veeder

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the Counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. Price, $2.00



The "Form UM" Magnetic Counter below counts operations or units of output from any distance that wires connect with machines.



Cut ½ Size

Mechanical contacts on your machine make and break the electrical circuit which operates the counter. The electro-magnetic drive can get its current from your regular lighting circuit Direct Current, (110 volts), or from storage battery.

Write us about that counting problem of yours—it's probably solved in the big Veeder booklet; copy free

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

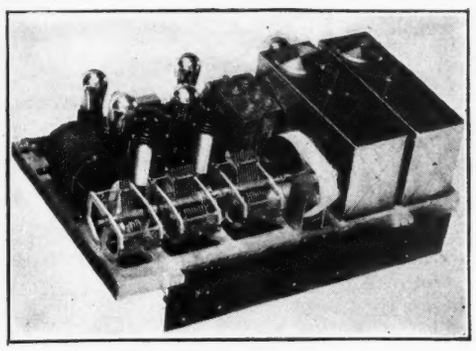
® This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Bremer Tully

THOROUGHBREDS—
with a past history that indicates what you may expect now.

NO ONE challenges the statement that B-T has always produced Radio products that have been more than ordinarily successful. We therefore believe that POPULAR SCIENCE readers will be interested when B-T announces a "*permanent model receiver.*"

The COUNTERPHASE-EIGHT and the new COUNTERPHASE-SIX are the supreme efforts of the B-T Company. The engineering skill, unusual designing and manufacturing ability for which B-T are known are more apparent than ever before.



Counterphase-Eight Chassis

A New Idea of Selectivity

Those familiar with the selectivity of the NAMELESS and original COUNTERPHASE will be astounded at the statement that B-T believes the new COUNTERPHASE the most selective set ever built. A feature entirely new in radio and exclusively B-T is largely responsible for the added degree of selectivity—THE REJECTOR STAGE.

Straight-Line-Selectivity condensers, designed expressly for these receivers tune the five stages with ONE CONTROL.

The *Station Indicator* employs B-T patented ideas not found elsewhere that permit absolutely accurate calibration of each receiver. You will instantly appreciate the simplicity of this new device.

Simplicity of tuning is the keynote—one station selector—no manual oscillation control—yet the new COUNTERPHASE is sensitive across the full scale.

Those who have examined these new models say they "run true to form."

It is not possible here to paint an adequate word picture of what you will find in these new Receivers. Go to an Authorized Dealer and ask for a demonstration. If that is not convenient, send for a copy of BETTER TUNING, 10th edition. In it we frankly discuss the merits of the new COUNTERPHASE. You will also find a discussion on the various types of B-Power Units.

If at all interested in radio you cannot afford not to know about these new products. The coupon is for your convenience.

Counterphase Receivers are not sold in kits but as complete sets only.

B-POWER UNIT

There is no radio product in which the user must place more confidence in the manufacturer than in a B-Power Unit.

This product is designed to deliver dependable B current. There are no knobs to turn and the voltage delivered is always known. Output is sufficient for multi-tube sets including power tube. It's different and we believe, better—

Not sold in kit form.

☐Please send the 10th edition "Better Tuning" for which I enclose 10c. ☐Literature on Counterphase Receivers. ☐Literature on Parts. ☐B-Power Units.

(Name)

(Address)

If a dealer and interested in securing exclusive territorial rights on Counterphase Receivers check here and attach to your letterhead☐
PS-10

Bremer Tully

Manufacturing Co.

520 S. Canal St. Chicago, Ill.

Lower Your Radio Upkeep—with UNITRON DEVICES

More power at lower cost—better volume yet clearer tone—these are the virtues you own when you have Unitron Radio Power. In radio the Unitron name is only a few years old, but industrial service has known their good repute for years.

There is among the ten Unitron current rectifiers, one that is perfectly what *you* want for *your particular* set. All are economical—money savers. And any one will give you better radio, *proved at the speaker*, than ever you had before.

This is the Unitron Trickle—$12.

An unusual electrolytic "A" trickle charger—with three distinct charging speeds, controlled by three-way switch. Thus the small or large battery can have exactly its current needs. Permanently connected to battery, can be turned off or on by use of the toggle switch, or can be kept charging continuously.

Rectifying elements guaranteed two years and will last a lifetime. Silent. Can't overcharge. Current cost 1-10 of a cent per hour when battery is charging. Mahogany Duco finished case, 9" x 3½" x 6½" high.

This is the Unitron No-Bee No. 90—$30.

For sets using up 90 volts—the ideal light-socket "B" power. Voltage up to 45 for detector circuit—and up to 90 for amplifiers at 25 milliamperes. Equipped with new Unitron Electrolytic Tube, which is guaranteed for two years and lasts many more. No hum or power distortion is possible. Connect the No-Bee the same as batteries and forget it. Can't run down. Economical. Costs only 1-10 of a cent an hour to run. Mahogany Duco finished case, size 9" x 3½" x 8¼" high. R.C.A. UX213 Tube can also be used.

This is the Unitron Charger No. 0—$28.

For overnight recharging of radio or automobile batteries subjected to heavy drain, this rectifier fills a great need. Charging rate 6 amperes. A two-way switch permits also recharging wet "B" batteries of up to 100 volts, using same charging clips. Equipped with Tungar No. 189048 or Rectigon No. 289414 Tube, which is guaranteed to serve 1000 burning hours. Charge tapers down as the battery regains full strength. Economical. Noiseless. Can be permanently connected to the set. Housed in Duco Mahogany finished case, 8½" x 6½" x 9½" high.

UNITRON
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RADIO POWER DEVICES

Send this Coupon for Details About the Various UNITRONS

FOREST ELECTRIC COMPANY
New and Wilsey Streets, Newark, New Jersey

☐ Please mail me literature that tells about the ten Unitron Light Socket Devices, and how little it will cost to equip my set, which is

a.....tube.....using

.....batteries.

Name.....

Address.....

City.....State.....

Check here ☐ if a dealer, and write your firm name below

.....

The Home Workshop

Stenciling Is Easy

(*Continued from page 66*)

furnish wall elevations (Fig. 3) showing suitable stencils and color treatment for painted wall decoration in both plain color and stippled effects. There are, however, some fundamental principles which should be observed.

"The size of the border should correspond to the proportions of the room. Smaller designs should be used in small rooms, also in low ceilinged rooms. Larger designs are better in larger rooms and ones with high ceilings. In some cases the space between molding and top of windows and doors will not permit the use of a deep stencil. Brighter colors are generally more desirable in smaller designs than in the large ones.

"The pattern should conform somewhat to the character of the room. For instance, the more conventional designs are especially adapted to rooms that are constructed and furnished along a severe style, while the more floral patterns are suited to rooms where the other features give a suggestion of beauty of line."

I POINTED out that motifs suitable for every room and for any decorative scheme may be obtained in stencils, and, of course, many people cut their own, which is not hard to do. Prepared cardboard for making stencils can be bought.

Hand shading also is sometimes done, especially in leaves and flowers. Outline stencils are used occasionally. In these only the outlines of the design are stenciled on the wall. When dry, the outlines are filled in with soft brushes of varying widths and often a cloth is used to stipple the design lightly. This takes off surplus color and removes brush marks. Certain spots sometimes are picked off by wiping with a cloth held over the finger, after the color has commenced to set, to produce what are called high lights.

The example shown in Fig. 3 is an effective combination of sponge stippling, which was described in the August issue of POPULAR SCIENCE MONTHLY, and stenciling. The wall is silver gray foundation color, sponge stippled first with sage green and sky blue in equal parts, and second with silver gray, one part, and ivory white, two parts. The first stencil color is white tinted with olive lake; the second is white tinted with chrome yellow medium. The ceiling is ivory white and the woodwork, that is, the trim around doors and windows, the baseboard and the picture molding, is extra dark mahogany.

Fun for Everyone

THE MOST fascinating game of the year has just been discovered. The November issue of POPULAR SCIENCE MONTHLY will tell you how to play it. It's simpler than crosswords, but fully as alluring. It's scientific, too, and there'll be prizes.

140-page Book full of life-size ruled forms, each one completely filled in The answer to problems of accounting and record keeping for any business or profession.

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MOORE'S LOOSE LEAF SYSTEMS
Used In 300,000 Offices
Ask about the New
MOORE'S VISIBLE RECORDS

Read interesting article on Page 4. "How $100 a Month, Invested Properly, Can Make You Independent."

Ship Model Making

How to Make Worth While Models of Decorative Ships

By CAPTAIN E. ARMITAGE MCCANN

A practical book which tells how any handy person can make models of a Picturesque Barbary Pirate Felucca and a Beautiful Spanish Treasure Galleon.

Ship Model Making gives full-sized drawings of every part required. This book describes how to make the models, what materials to use, how to fasten together and color them, how to make the spars and rig the ships. You do not need to know ships to make these models, the book describes everything in detail, but you may use your ingenuity and artistic sense in decorating and can make them larger or smaller than the scale given.

Profusely illustrated—Scale drawings

Price, $2.50

POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

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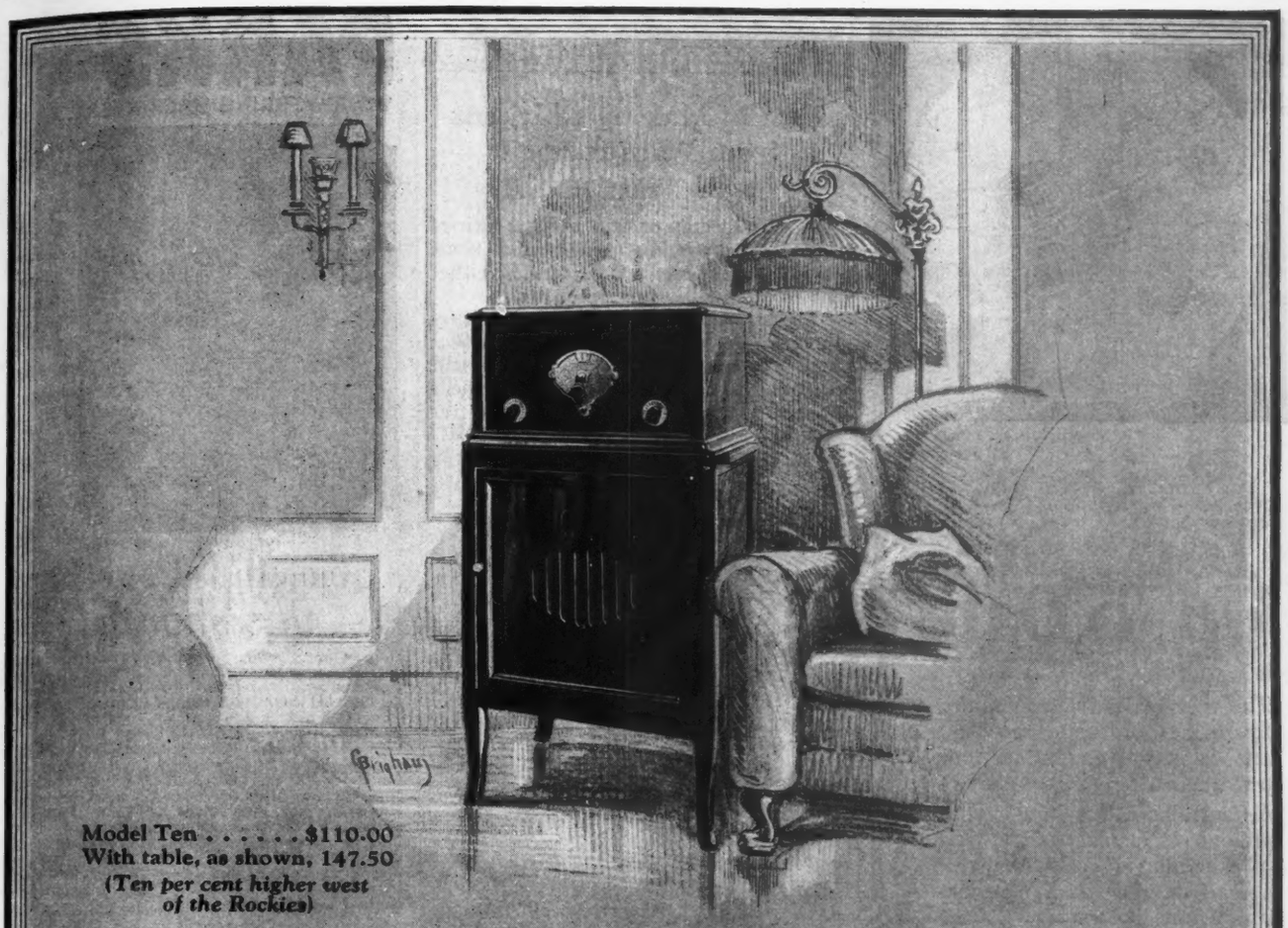
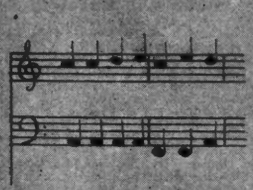


Model Ten $110.00
With table, as shown, 147.50
(Ten per cent higher west of the Rockies)



With a FERGUSON you can identify each instrument. You hear each note—treble *and* bass. The harmony, the "fullness", of the whole orchestra leaves nothing to your imagination.

THE program of your choice, in an instant, by means of one tuning control—calibrated in meters! Surpassing fidelity of tone, through a powerful 3-stage amplifier, of advanced design, that gives you the true "expression" of a distant artist. Marked selectivity, due to complete shielding. These are yours with a FERGUSON. See, hear and *compare* in appearance, in performance!

J. B. FERGUSON, INC.
225 West 57th Street, New York, N.Y.

No Seasonal Models—
Continually Developing Refinements

Ferguson

The Gold Standard of Radio Receivers

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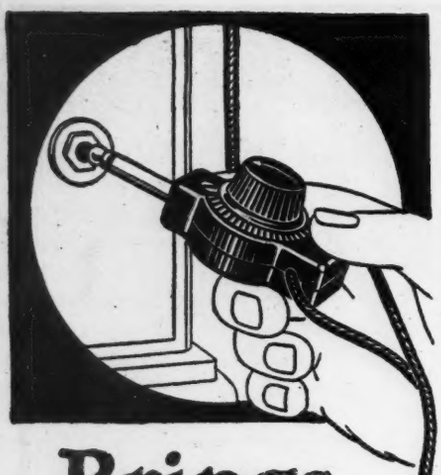


Brings Your Set Up To Date

The only real advance claimed by makers of this year's best sets is improvement in tone performance.

A Centralab Modu-Plug in your present set in place of the loud speaker plug will give you this new advantage—easy, sure control of tone volume.

Tune in your station on the set, then modulate the tone volume with the Modu-Plug to the exact point of greatest distinctness and most pleasing reception, by simply turning the small knob on the plug.

This new invention enables you to get better, sweeter tuning by transferring the final touch to the Modu-Plug between the set and the speaker.

If you've been exasperated by losing a good station when you were working the dials to get the right tone volume—then use a Modu-Plug. It will give you delightfully easy tone volume control.

$2.50 at your dealer's, or mailed direct on receipt of price.

CENTRAL RADIO LABORATORIES
10 Knefe Ave., Milwaukee, Wis.

Centralab Radiohm permits clear, true-tone reception by holding the sensitive regenerative position which immediately precedes the oscillation point, without distortion or loss of selectivity. A standard unit on leading sets. Retail price, $2.00, at your dealer's or from us.

IS **Centralab** CRL

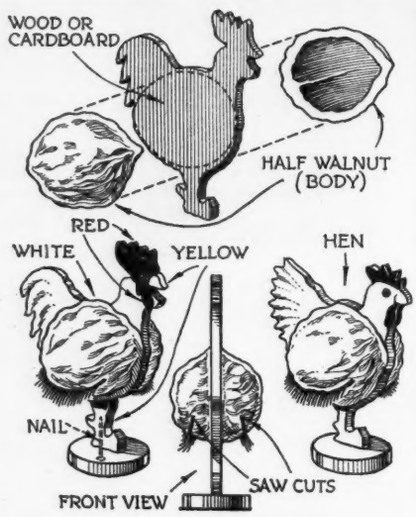
The Home Workshop

Fun in Making Chickens from Walnut Shells

By F. Clarke Hughes

ONLY a scrap of thin wood, a pair of English walnut shells and some liquid glue are required for making either the rooster or hen illustrated.

First trace one of the walnut shells on the board; then copy the outline of either rooster or hen so that the shell body will come in the proper place. Cut out this central body piece with a coping or fret saw. Heavy cardboard can be substituted for wood, and in that case a knife



This walnut shell rooster and hen serve as amusing and novel table decorations

or scissors will serve for cutting.

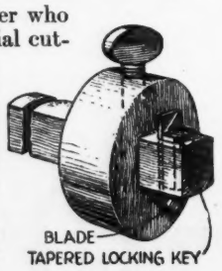
Glue a half section of the walnut shell to each side and, when dry, sandpaper or whittle off any uneven edges. Two small saw cuts should be made in the shells, as shown, to allow wing feathers to be inserted.

A wooden button mold or a button may be used for the base. Paint the finished model with oil colors as indicated.

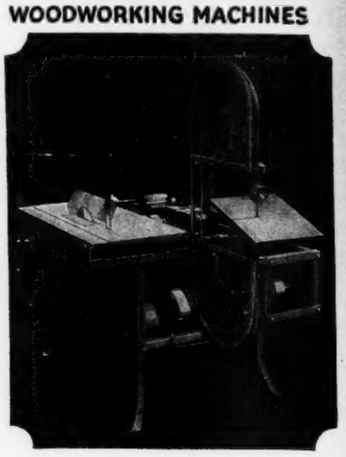
If a few bits of old ostrich plumes or thin feathers are glued on the tail, they will add greatly to the appearance of the bird, although this was not done in the case of the original models and, therefore, has not been shown in the drawings.

Tool for Cutting Thin Strips

THE woodworker who has not a special cutting or slitting gage among his tools can improvise one when it is necessary to sever a number of strips of thin material. Remove the point from a discarded marking gage, cut a semicircular opening through the bar near the end, and insert a cutter made from an old hacksaw blade or piece of saw steel. Hold the blade in place with a wedge.—W. J. Edmonds, Jr.



PARKS
WOODWORKING MACHINES



Cabinet Shop Special $290 with Motor

See this PARKS *this month!*

IS October is "Parks Cabinet Shop Special month" with Parks dealers everywhere. In their showrooms this wonderfully popular woodworker will be on display and in many instances in actual operation. Parks Cabinet Shop Special No. 10 at $290.00 is the handiest machine Parks ever built! Big enough to turn out first-class work—small enough to fit in a small shop or your basement—a real machine built for real work without freakish "stunt" designing. It makes practically any cut and includes rip and cut-off circular saw, jointer, and band saw. Lathe and shaper may be added at small extra cost. Every man who does cabinet making or woodworking of any kind wants this splendid machine. It is the biggest woodworking machinery value on the market today. Be sure to see this Parks this month *in these dealers' showrooms*

ALA.: Moore, Handley Hdwe. Co., Birmingham; McGowin-Lyons Hdwe. & Supply Co., Mobile; Alabama Mchy. & Supply Co., Montgomery; ARK.: Ben D. Schaad Mchy. Co., Little Rock; CAL.: Shaw-Palmer & Bakewell Co., Los Angeles; Harron-Rickard & McCone Co., San Francisco; COLO.: H. W. Moore Equipment Co., Denver; CONN.: Lunt, Jillson Co., Manchester; FLA.: Cameron & Barkley Co., Jacksonville; Cameron & Barkley Co., Miami; Cameron & Barkley Co., Tampa; GA.: R. S. Armstrong & Bro. Co., Atlanta; ILL.: Woodworkers' Tool Works, Chicago; KY.: Roy C. Whayne Supply Co., Louisville; LA.: Clark D. Shaughnessy Co., New Orleans; MASS.: Lunt, Jillson Co., Boston; MICH.: Riverside Mchy. Depot, Detroit; McMullen Mchy. Co., Grand Rapids; MINN.: Raymer Hdwe. Co., St. Paul; MO.: Standard Machine Tool & Supply Co., Kansas City; S. T. Hatcher Co., St. Louis; NEB.: Diehl Mchy. & Supply Co., Omaha; N. Y.: Interstate Mchy. Co., Troy; Chas. R. Mapps, 178 Lafayette, New York City; N. H.: Brackett & Shaw Co., Somersworth; N. CAR.: Amer. Hdwe. & Equip. Co., Charlotte; Raleigh Iron Works Co., Raleigh; OHIO: J. C. Baker, Columbus; OKLA.: Universal Supply & Mchy. Co., Tulsa; ORE.: Portland Mchy. Co., Portland; PA.: K. O. Dilmars, Bourse Bldg., Philadelphia; Coblentz Tool & Supply Co., Erie; S. CAR.: Cameron & Barkley Co., Charleston; TENN.: Peglar Mchy. Co., Chattanooga; Iddins Mchy. Co., Knoxville; Harvill Supply Co., Nashville; Carriage & Wagon Supply Co., Memphis; TEX.: Universal Supply & Mchy. Co., Amarillo; Southern Implement Supply Co., Dallas; Don A. Carpenter & Co., El Paso; Peden Iron & Steel Co., Houston; Peden Iron & Steel Co., San Antonio; UTAH: Salt Lake Hdwe. Co., Salt Lake; VA.: James McGraw, Inc., Richmond; W. VA.: LaLance Equip. Co., Huntington; WIS.: Shadbolt & Boyd Co., Milwaukee; WASH.: Union Mchy. & Supply Co., Seattle; FOREIGN: Sipe Mchy. Agency, San Jose, Costa Rica; P. I. Zayas, Havana, Cuba; Weir Mchy. Co., Vancouver, B. C.; Morris, Black & Matheson, Ltd., Auckland, N. Z.; West India Mchy. & Supply Co., San Juan; P. R.; Bournival & Co., Montreal, Can.; Engineering Supply Co. of Australia, Ltd., Brisbane, Australia.

See this Parks by all means! If you can't, then write us for circular No. 10 and the new Parks catalog.

The Parks Ball Bearing Machine Co.
1547 Knowlton St., Cincinnati, Ohio
Canadian Factory: 200 Notre Dame East, Montreal, Canada.

ADDING MACHINE
Fits Vest Pocket

A marvelous calculator. Does the work accurately and quickly as a $500 machine. Invaluable to anyone who uses figures. Don't carry pad and pencil. This startling invention will solve all problems in a minute. Business men, students, professional people, all need this HANDY HELPER.

SEND NO MONEY
Don't send money, just name and address. Pay postman only $2.95 plus few cents postage. Try it for 10 days. Your money back if not satisfied.

Counts To 1 Billion

Results in plain sight all the time—clears instantly. Made of steel and brass, in handsome case, fits vest pocket; weight only 3 oz. Send for yours now—you'll save time and money.

PRICE $2.95

Reliable Adding Machine Corp., Dept. 157
184 W. Washington St., Chicago, Ill.

AGENTS Here's a dandy chance to make money. Everybody wants one. Fine profit. Write for new offer.

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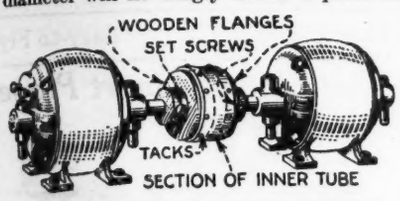
The Home Workshop

Flexible Motor Coupling Made with Inner Tubes

A FLEXIBLE coupling often will add greatly to the usefulness of a fractional horsepower electric motor in the home and home workshop.

To make a coupling of this kind requires only two hardwood flanges and a short length of discarded inner tube. The flanges are turned so that the largest diameter will fit snugly inside a piece of



A small motor and generator connected with a coupling that compensates for misalinement

3 or 3½ in. inner tube. One is drilled to fit the motor shaft and the other to fit the shaft of the driven machine.

The rubber is tacked to the flanges, which are fastened to the shafts with set screws. Discrepancies in horizontal and vertical alinement are compensated for without lost motion or backlash.

The home mechanic who developed this coupling uses it to connect a one-quarter horsepower washing machine motor to a small generator and to connect the motor to the countershaft of a bench lathe. Many other uses will suggest themselves.—HAROLD N. WHITMORE.

Amazing Block Puzzles

(Continued from page 78)

hands are needed, especially if the blocks do not fit tightly together.

Two more F's are taken with an E at the farther end and inserted at the rear in the upper slots formed by the four G's (Fig. 4 at top). Another G is placed opposite the E, as was done before.

If it is desired to build the puzzle around the one of six blocks, now is the time to insert the latter. It should be in the position shown in Fig. 5; that is, the length of the upper end should be at right angles to the upright G's.

Two E's next are placed in the inside cuts of the F's. One is shown in place in Fig. 4 at the bottom. The other occupies a similar position at the top. The inserted six-block puzzle is not shown in this figure (4), but the two E's will hold the six-block puzzle rigidly in place, if it is to be used.

Four G's are now fitted and bound with two more G's in exactly the same manner as was done previously. Nothing remains but to insert the A blocks, of which there are four.

For this puzzle accuracy is required in making the cuts. If measurements are taken from the center of the blocks instead of the ends it will avoid the trouble that may arise from variations in length.

Those who love to whittle and exercise their ingenuity can find an almost endless number of ways to combine the blocks in this form.

That well-groomed look

Professional men and successful business men—doctors, bankers, lawyers—know that a clean, fresh, well-groomed appearance is an immeasurable asset.

This unique creation, Palmolive After Shaving Talc, gives that fresh, clean look you want. It removes after-shave "shine." And yet leaves no "powdered" look.

It is a powder for men, providing features unknown before.

Personal—to all Palmolive Shaving Cream users

We have prepared a new-type talc for you that ends all shine without that powdered look—Now, accept a can of this unique creation—just send coupon

GENTLEMEN:

We have developed a new-type talc for you.

A talc that takes all that after-shave shine away; yet that's invisible on the face.

A talc that meets the desires of gentlemen in providing the well-groomed appearance they want, without the "powdered" look that followed old-time talcs.

Now as a favor to us, please accept a two-weeks' trial can to test. Just mail the coupon below. Let us show you what we have done.

Used after shaving, all "shine" goes—yet no trace of powder shows

A *new-principle* creation

We are experts in skin care, as you know. We make Palmolive Soap, the leading toilet soap of the world. Palmolive Shaving Cream—the most amazing success in its field—is another of our creations.

Palmolive After Shaving Talc is different from any preparation of like purpose you have ever tried. It is based on scientific findings. It is the result of long experiment in the noted Palmolive laboratories.

Before offering it to you, we spent some years in perfecting it.

Also 10-day tube of Palmolive Shaving Cream

The unique creation that's winning thousands away from old-time shaving soaps—corrects five mistakes of ordinary shaving preparations for you. Send the coupon.

We tried scores of formulas, tested scores of powder blends, tried colors without number to find one that would smooth the face, yet not show a trace of powder.

We consulted skin specialists on what was best for the skin. Then in collaboration with them, perfected this scientific creation providing two unique features unknown before, we believe, in either talc or powder.

First: It is invisible. Men don't like powder to show. Second: It is a scientific combatant of skin roughness—keeps the skin smooth and soft.

USE always before an evening at theatre, dance —or wherever an appearance of fresh grooming is important

* * *

On the market but a short while, thousands of men to whom good grooming is essential are making its use a twice a day habit—after shaving in the morning; before dinner in the evening.

We believe it will delight you. Send us the coupon. Do it now. We'll send you a can of this talc, also a 10-day tube of Palmolive Shaving Cream.

TRY IT—FREE

and a 10-day tube of Palmolive Shaving Cream

Simply insert your name and address and mail to Dept. B-1246, The Palmolive Company (Del. Corp.), 3702 Iron St., Chicago, Ill.

Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.

.....

.....

Please print your name and address clearly

PALMOLIVE AFTER SHAVING TALC

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Double Rigid
Double Rapid

Saves Time!
Saves Your Face!

GET next to the Gem Double Life Blade! Let your face revel in those double-cool, double-clean, double-quick Gem shaves!

Gem Blades are double-thick and double-reinforced with a double-strong backbone! They won't bend! They won't quiver! They're double-keen! They smooth away the whiskers at the dermal line!

Double-protected, double-sealed—they're backed by a double-satisfaction guarantee! Buy a double supply today. Sold everywhere.

P.S. Double your shaving joy with a Gem de Luxe Razor. It's scientifically right, perfectly balanced. If you have an old Gem Razor that isn't doing its bit, send it to our service department, our guarantee means something. Send it to the

GEM SAFETY RAZOR CORP.
Brooklyn, N. Y.

GEM
Double Life
BLADES

The Home Workshop

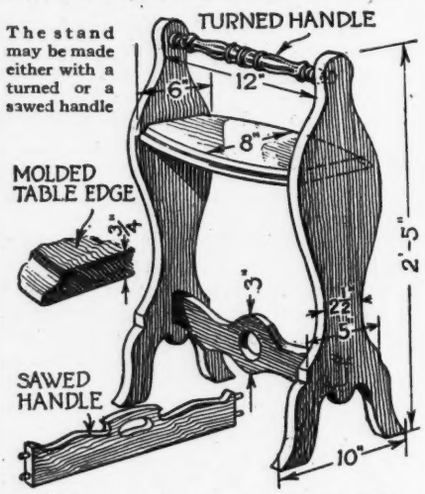
A Smoking Stand You Can Be Proud of Building

By KENNETH R. LAVOY

FOR convenience, most of us want a complete smoking unit—a portable stand equipped with ash tray, match holder, and other accessories. This stand usually looks best if made of wood to match the furniture in the home. Mahogany and walnut are among the pleasantest woods to work with and take such a beautiful finish that it pays to use one or the other, but red gum and whitewood, which are cheaper, will serve effectively if great pains are taken in finishing them.

Two types of handles are shown. The turned handle is better looking, but the alternative type has the advantage of not requiring lathe work.

Draw the design for half of one of the ends on a piece of heavy wrapping paper. Lay the pattern on the center line of a



straight grained piece of wood 10 by 29 in. and mark the curves. With band saw, turning, or keyhole saw cut out the shape. Smooth the edges with spokeshave and file.

When finished satisfactorily, trace the outline on a similar piece of stock and repeat the operations.

The stretcher is made in the same manner. Next get out the shelf. The curved edges can be planed with a universal plane or sawed to shape and the edges curved by using a scraper filed to the desired design.

Turn or cut out the handle, leaving ½-in. dowels or tenons on each end. Next sandpaper all parts.

The shelf and stretcher are bored for dowels and corresponding holes are bored in the legs. Cut dowels the right length, glue, and assemble. Clamp firmly, using small scrap pieces of wood to protect the wood from clamp marks. Test for squareness and remove any surplus glue with a cloth dampened in hot water.

The piece should be stained, filled if necessary, and varnished, or finished in any way preferred.

The stand also might be made of some soft wood and finished in enamel or lacquer colors with a decalcomania (transfer) or stencil design on the sides.

Build Your Own Airplane

Blue Prints and Material Now Ready for Builders

Easy to Buy **Easy to Fly**

The Lincoln Sport Plane

100 Miles per Hour with 30 H. P. Engine. Special Sale on Complete Set of Parts. Complete set constructional details of Sport Plane 50c. Send Today.

The Lincoln Monoplane

Real performance in a light Monoplane. Blue Prints are life size. A Motorcycle engine will give this plane real performance.

OUR NEW AIRCRAFT INSTRUCTION BOOK **FLIGHT** has over 100 illustrated photos of American and foreign planes. A complete history of Aviation. It sells for $1.00 postpaid.

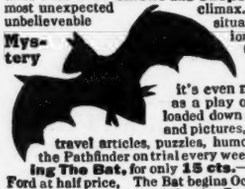
Blue Prints of both planes on special sale NOW! Send 25c for illustrated catalog. Write today.

LINCOLN STANDARD AIRCRAFT COMPANY

Dept. D-S **Lincoln, Nebraska**

Everybody wants "THE BAT"

the world's greatest mystery story and now for the first time you don't have to pay $2.00 for the book. You can read it **Free** in the **Pathfinder,** the old reliable home weekly published at the Nation's Capital. From the beginning **The Bat** just makes you throb with **excitement** and **suspense;** at the end you get the most unexpected climax. It is full of **thrills,** almost unbelievable situations and revelations. Millions of people have seen it on the stage or screen and have sat spellbound. Now you get it in serial form and it's even more thrilling as a story than as a play or movie. The Pathfinder is loaded down every week with world news and pictures, stories, informing editorials, travel articles, puzzles, humor and miscellany. You get the Pathfinder on trial every week, **13 big issues including The Bat,** for only **15 cts.**—a bigger bargain than a new Ford at half price. The Bat begins Oct. 30. Send order now (with 15 cts. in coin or stamps) for the Pathfinder 13 weeks. Address: **The Pathfinder, 129 Langdon Sta., Washington, D. C.**



Advice for POPULAR SCIENCE MONTHLY readers regarding safe and profitable investments. **See Page**

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The Home Workshop

Amusing "Potluck" Game Played with Balls

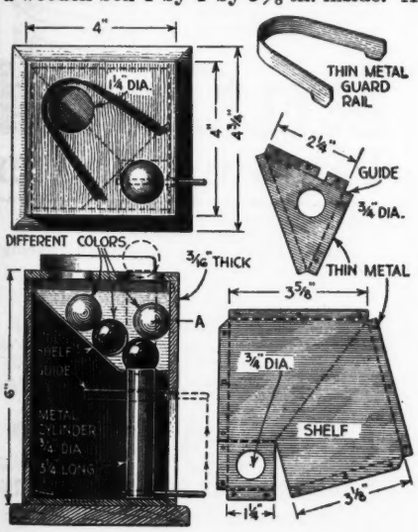
Raising the handle causes a ball to appear; its color determines what to add to the score

"POTLUCK," a word that suggests the dipping out of a dish of stew from a kettle—there may be a chunk of meat in the dipper and then again, there may not—would be a good name for this game of chance. No one knows which ball will come in view when the handle is raised.

To play the game, lift the handle up as far as it will go, note the color of the ball, push the ball back through the larger opening, and release the handle.

The red ball counts 15; the blue, 10; the yellow, 3; the black, 1; and the white, nothing. If a ball lodges in the position marked A, it can be pushed back by hand.

The construction of the game is made clear in the drawings. The case is merely a wooden box 4 by 4 by 5⅝ in. inside. A



Top view and a section through the game box; the patterns for the hopper, guide, and guardrail

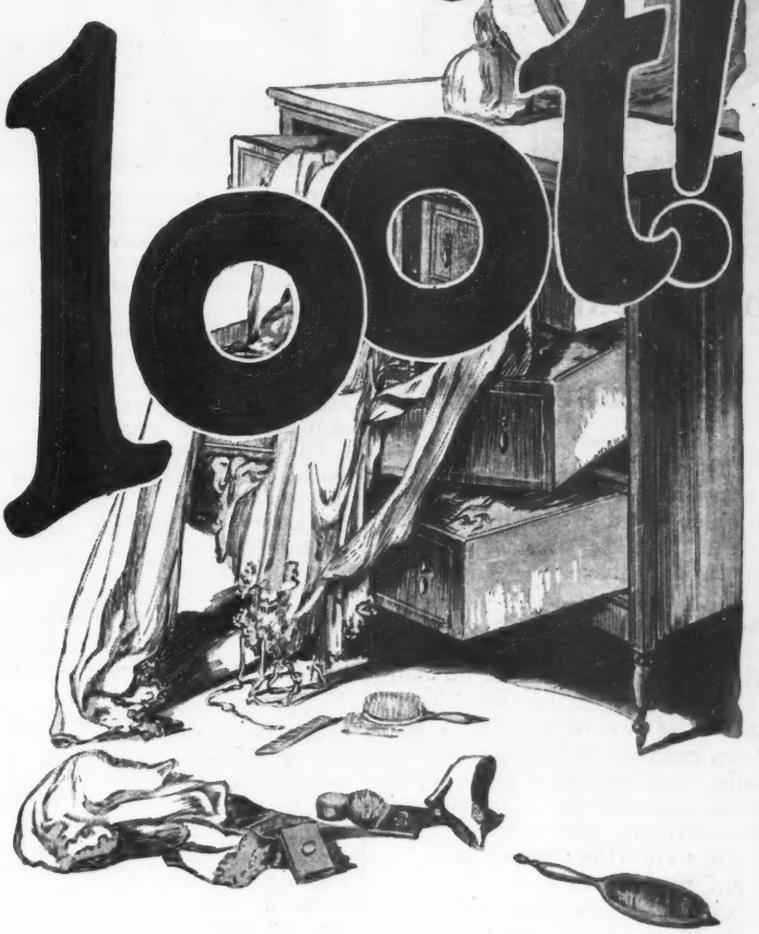
metal hopper, which is cut to the pattern shown, is fastened in the upper section. A sliding metal cylinder ¾ in. in diameter and 3¼ in. long is inserted, as indicated, for raising a ball into view. Note how the cylinder passes up and down through a thin metal guide.

The balls, which may be of wood or any other hard substance, should be 1 in. in diameter.—DONALD W. CLARK.

TRADE YALE MARK

saves your property from becoming

loot!



Burglary insurance may reimburse you in cash. But it will not return the cherished valuables that money cannot replace. Adequate protection—YALE protection—will prevent your property from becoming loot.

The Yale No. 192 Rotary Bolt Deadlock, the Yale No. 10 Steel Bar Deadlock, the Yale No. 44 Automatic Deadlatch—all are physically able to outmatch the housebreaker—all are cannily designed, sturdily built, shock-resisting guardians of life and property.

Go to your dealer. Select one of these Yale Locks and enjoy proper protection. Send for booklet, "Yale Guards Your Treasures."

The Yale & Towne Mfg. Co., Stamford, Conn., U. S. A.

Canadian Branch at St. Catharines, Ont.

No. 10 Deadlock

No. 192 Deadlock

YALE MARKED IS YALE MADE

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The body of the "Yankee" Vise, with the work in it, is carried to the drill press. Hardened steel block, with V-shaped grooves, holds round or irregular shapes.

This means Accuracy and Faster Work

You buy and use "Yankee" Tools because they are different—and will work in ways and places in which no other tools will work.

The "Yankee" Vise is detachable from its base.

Sides, end, top and bottom, and the sliding jaw, are accurately machined to hold work square—with vise flat, on sides, or on end.

For many operations the "Yankee" Vise can be used as a jig. From machine to machine it goes—the work kept in original alignment. You can get the size most convenient for your work.

No. 1994—Jaws open 4 in.
No. 1993—Jaws open 3⅛ in.
No. 1992—Jaws open 1 15/16 in.
No. 1991—Jaws open 1½ in.

The "Yankee" Vise has swivel base. Cam-throw lever locks vise in any position.

Some Other *"Yankee"* Tools

Ratchet Bit Braces. Ratchet Breast, Hand, Chain and Bench Drills. Ratchet Tap Wrenches. Spiral and Ratchet Screw-Drivers. Plain Screw-drivers. Automatic Push Drills.

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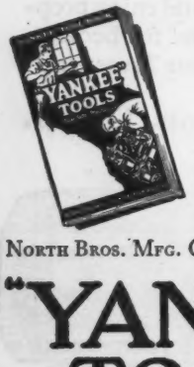


"Yankee" on the tool you buy means the utmost in quality, efficiency and durability.

FREE
New "Yankee" Tool Book

This interesting little book is for all lovers of fine tools. It tells just what you want to know about all the famous "Yankee" Tools. Write for your copy today.

North Bros. Mfg. Co., Philadelphia, U.S.A.

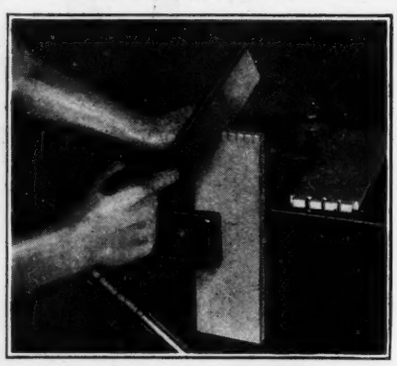
"YANKEE" TOOLS

Make Better Mechanics

The Home Workshop

Dovetail Joints

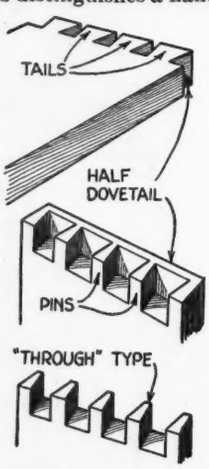
(Continued from page 76)



7 Saw down on the lines at an angle; the wood between the pins then can be carefully removed with a chisel

perienced mechanic often lays out the tails by eye. He takes care, if doing fine work, to make the pins much narrower than the tails. This distinguishes a hand-made dovetail from the much coarser and commoner machine dovetail, in which the pins and tails are the same width.

The illustrations (1 to 8), show how to make a half dovetail. Substantially the same process can be followed in making a through dovetail joint, except for the preliminary laying out. The accompanying drawing clearly shows the difference between the two types.



Good proportions for multiple dovetails are essential

The gaged line at the end of the drawer front referred to in Fig. 2 may be from ⅛ to ¼ in. in from the front face. This lap is shown in the middle of the three drawings; compare with Figs. 1, 2 and 6.

8 Properly made, the joint may be pressed together by hand. Apply a little glue before assembling it

A perfect patch

Makes cracked walls look like new

WHEN you fill a crack or hole with Rutland Patching Plaster, you can paint or paper over it without shellacing. The patch will not "spot through."

You can do such a perfect job that the wall looks as good as new, and the patch is as lasting as the wall itself. It will not crack, crumble or fall out. It will not shrink as plaster of paris shrinks.

Rutland Patching Plaster is easy to use. Comes in handy cartons, ready to use. Just add water and apply.

Paint, wall-paper, and hardware stores sell it. If your dealer hasn't it, mail coupon for 2½ lb. carton. Pay the postman 30 cents plus postage. Rutland Fire Clay Co., Dept. R5, Rutland, Vermont.

Other Uses

Mending stucco or cement walls

Pointing brick work

As a mortar to hold loose tiles in bathroom walls or floors

Rutland Patching Plaster

RUTLAND FIRE CLAY CO.
Dept. R5, Rutland, Vermont.
Send me 2½ lb. carton of Rutland Patching Plaster.
Name.....
Address.....
My dealer's name.....

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THE PERFECT POTENTIOMETER

Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 200 and 400 ohm ratings.

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Electric Controlling Apparatus
293 Greenfield Avenue Milwaukee, Wis.

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The Home Workshop

Tricks You Need to Know

When Inclosing an Open Porch

By A. E. Elling

IF YOUR house has an open front porch of reasonable size, you can improve the architectural appearance of the building greatly and at the same time increase its resale value by inclosing the porch. This has the effect of adding a room to the house. Indeed, the inclosed porch, which is now being made a feature in so many new houses, is utilized as a sitting room in many cases, at least during the milder seasons of the year. If radiators are provided, it can be used all year round.

There is nothing difficult about inclosing the average porch. It is a job any

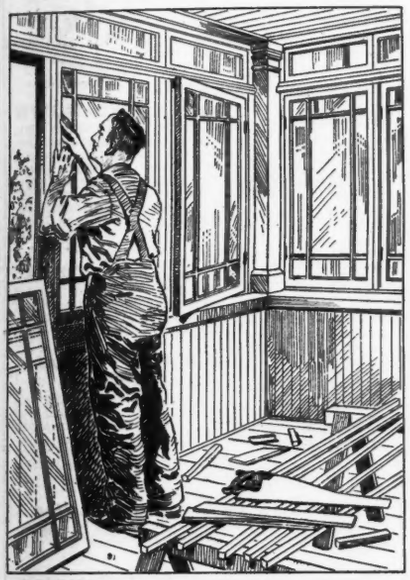


Fig. 1. When you are inclosing an open porch, you are really adding an extra room to your house

handy man can undertake with entire confidence of success. The main thing is to be familiar with the rudiments of the work and to plan the construction carefully in advance.

As open porches vary in design, the columns of some being square and others being round, some having rails and others being without them, two methods are illustrated. One (Figs. 2 and 3) suggests a simple yet workmanlike way of inclosing a porch with round columns; the other plan (Figs. 1, 4 and 5) is for a porch that has a railing and square columns. Various modifications and combination of the two types of construction can be made to suit individual needs.

It pays to make a sketch of what you propose to do and a tentative list of the necessary lumber, sash and doors. Then you can find out from your lumber dealer what he has in stock of the needed materials and what will have to be made to order.

In the case of (*Continued on page 110*)

How to Make Better Christmas Gifts

Wonderful New Way to Improve Your Craftmanship

LePage's New Books Will Show You How

NOW WITH the coming of the holiday, gift-making season, when the man who has a home workshop especially enjoys his hobby of making useful, practical gifts that can be used and appreciated by everyone in his home—come these two NEW LePage's Craft Books to show you how to make better Christmas Gifts and how to improve your craftsmanship. The titles of these two books are, "LePage's Practical Suggestions for the Home Workshop," and "LePage's Gesso-Craft Book."

Naturally when you tackle the making of an article like a breakfast nook, ship model or cedar chest, you want to come as near as possible to equaling the skill of the trained cabinet-maker. One of the things which he knows that you also must know is how to make strong joints—joints that combine strength with gracefulness and beauty. The only way to do this is with the use of glue, and this is exactly the information given you in these books. They tell you how to make strong joints with glue, and not only with glue, but with glue in its most convenient form—LePage's Liquid Glue.

Handiest Tool *in Your* Workshop

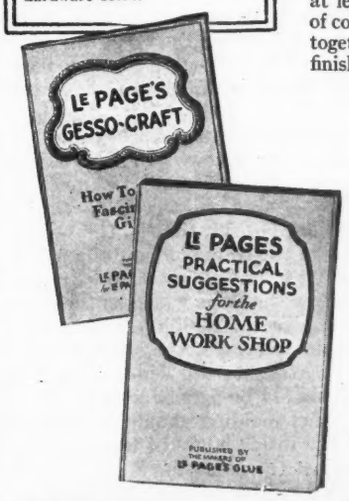
Perhaps you have never thought of the special advantages of using LePage's Liquid Glue. It is always ready for immediate use. No weighing, soaking or heating is required. Its quality is always the same. It "sets" slowly enough so that you have plenty of time to place the joints together exactly as they should go. Slow setting also allows LePage's to penetrate the wood, increasing the strength of the joint. LePage's Liquid Glue is equal in strength to any animal glue. Buy a can for your workshop. It is the easiest, quickest, handiest form of Glue. Insist on LePage's.

Recipe for making LePage's GESSO

To make one cup of LePage's Gesso, you need 1 gill can of *LePage's Glue*, 1¼ cups whiting, 3 teaspoons linseed oil and 3 teaspoons varnish. Place whiting in mixing bowl and pour in slowly in this order: LePage's Glue, linseed oil and varnish. Mix until smooth. All ingredients obtainable at nearest hardware store.

Improve Your Craftsmanship

THESE books also show you how to cover up small defects in your craftsmanship. Now and then a tool will slip and an error is made. Or there are holes to be filled where nails or screws have been countersunk. Or the edges of a joint are not exactly even. A simple new way to repair these defects is with the use of LePage's Gesso instead of putty. LePage's Gesso will stick to any surface—wood, metal, glass, etc. It can be sandpapered, planed and painted or stained just like wood. We give you in the small panel at left a simple formula for making LePage's Gesso, but of course we tell you more about it in the books themselves, together with practical information on decorating your finished articles with Gesso.



Send 10 cents for these NEW LePage's Books

The practical and useful help of these two books is yours for only 10 cents. Just write your name and address on the coupon below, tear the coupon out and mail it to us today with 10 cents in coin or stamps, and we will at once send you a copy of these two LePage's Books, postage paid. Address, LePage's Craft League, Dept. 001, Gloucester, Mass. Tear out the coupon now so that you will not forget it.

LE PAGE'S GLUE
Bottles, Tubes, Cans

LePage's Craft League,
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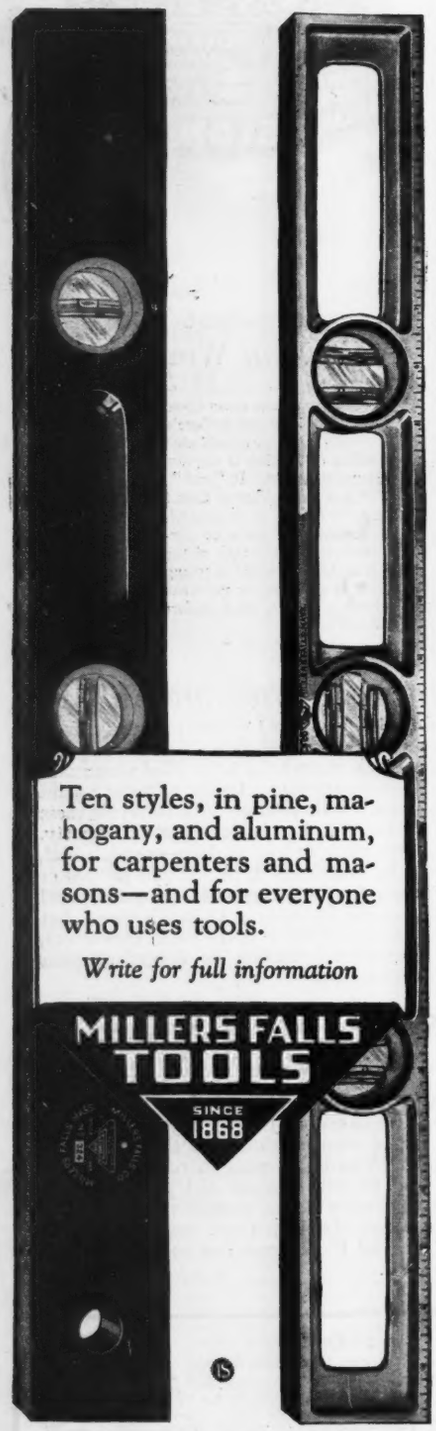

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28 Warren St. New York — 9 S. Clinton St. Chicago

Manufacturers of Mechanics' Tools, Hack Saws and Automobile Tools.

The Home Workshop

Inclosing an Open Porch

(*Continued from page 109*)

a porch with turned columns, begin work by removing the lower rails and balustrades. The top-rail or handrail may be retained and utilized if it is 6 in. in width. If it is narrower, hammer it down 1⅛ in. and place a wider rail on top. Add a molding below the new piece to give the appearance of a heavily built rail.

THE pieces marked No. 1 and No. 7 (Fig. 3), which are 1¼ by 2½ in., are the first to be fitted. Cut them to fit tightly between the soffit and rail and between the rail and floor. The fitting is accomplished by plumbing them carefully in place and marking them with scribers or compass to match the post. Instead of trying to fit them neatly to the molded base and cap, simply cut a recess in these members to the depth of about ½ in.

When the pieces have been sawed out, a half-round plane or a gouge should be used to hollow out the edge that fits against the post. Then screw these parts in place.

The next member to be erected is that marked No. 2, which is 1⅛ by 2¼ in. The stock must be rabbeted to receive the sash. Nail this member to the piece already fitted and also carry it along the top.

Outside the pieces No. 1 and No. 2 and covering the joint between them is a strip 1¼ by 1⅛ in., marked No. 4. It is the hanging stile for the screens. The corresponding member that runs across the top is only one-half the thickness, or ⅝ by 1⅛ in. The screens (No. 5) fit into the rabbet thus formed.

THE rail, No. 6, should have a slight bevel outward to shed the rain.

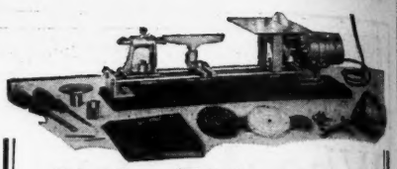
In the section below the rail, a strip, No. 8, which is 1⅛ by 1¼ in., is nailed on. Cross battens of 2 by 2 in. rough stock are nailed lengthwise of this lower section, and ½-in. ceiling (tongued and grooved) stock is nailed on the inside, as at No. 9.

The panels, No. 10, are all ⅞-in. stock. They should be screwed to the back of the frame, which should be made as follows:

The stiles, No. 11, that is, the vertical members of the frame outside the panels, are about 4 in. wide. The top-rails should show the same width as the stiles, but as a piece of molding goes against them under the rails, the stock actually should be at least 1 in. wider. The bottom rail should be a trifle wider still. A heavy panel molding should be mitered around the inside edges of the stiles and rails against the panels.

If it is desirable to make divisions between the columns, two pieces of stock similar to that marked No. 2 should be nailed together back to back with a piece of No. 4 covering the joint outside and a small fillet (No. 23) to conceal the joint inside. Note this detail in Fig. 3.

A headlight (*Continued on page 111*)



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Attach to any lamp socket and convert your bench to a complete private workshop. Have the chips flying in five minutes after receipt.

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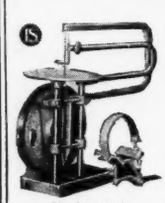

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Test the Speed Way Shop for 10 days in your own home. If it does less than we claim, return it.

Free Blueprint Service

Each month for a year we furnish a free blueprint of your selection and help you in other ways to get maximum service from the Speed Way Shop and Tools. Write for list of blueprints.

Write Today For Full Information

Every tool in the "Shop" is high grade, for regular work. A money maker for the small job man. Write today.

Electro-Magnetic Tool Company

1830 S. 52nd Ave., Cicero, Ill. (Adjoining Chicago)

Dept. 510, ELECTRO-MAGNETIC TOOL CO.

Dear Sirs: Please send me full particulars about 10-day free trial, free blueprints and $10 down payment.

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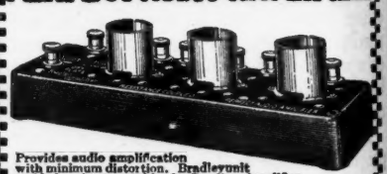
Bradley-Amplifier

Resistance-Coupled

PERFECT AUDIO AMPLIFIER



Provides audio amplification with minimum distortion. Bradleyunit molded resistors used in the Bradley-Amplifier do not vary with age and are not affected by atmospheric conditions. Can be used to replace transformer amplifiers in standard radio sets with decided increase in tone quality.

Allen-Bradley Co.

Electric Controlling Apparatus

293 Greenfield Avenue Milwaukee, Wis.

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The Home Workshop

Inclosing an Open Porch

(*Continued from page 110*)

often is placed over the windows, especially when the porch is high (Fig. 1). This construction requires a transom bar, a detail of which is shown in the lower right-hand corner of Fig. 3. It is made up of No. 20, 21 and 22 combined with No. 2. The bar should be fitted together securely and neatly at the desired height.

Either casement, that is, hinged sash or single sash may be obtained to suit the openings at any sash and door mill or through your lumber dealer. The sash (No. 3, Fig. 3) nearest the columns may be hung on hinges and the others made stationary with screws. If dividing pieces have been provided between the columns, all the sash may be hung so as to open. If there is a headlight (No.19), it is nailed fast. Screens are made and fitted to go outside. They may be kept in place by buttons or screws or with ordinary screen hangers.

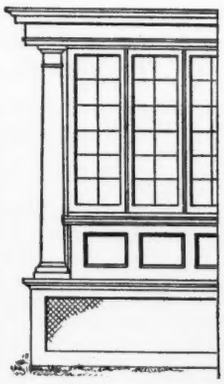

Fig. 2. Method for porch with round posts

The door opening will be defined by the space between the columns opposite the front door. A single door or a pair of doors may be used. Scribe pieces similar to No. 1 and No. 7 and fasten to the columns. Two jambs or posts are nailed in place between the porch floor and the soffit. Doorstops are nailed to these posts. If headlights are to be used, there should be one over the door, as over the windows, supported by a transom bar.

If it is wished (*Continued on page 112*)

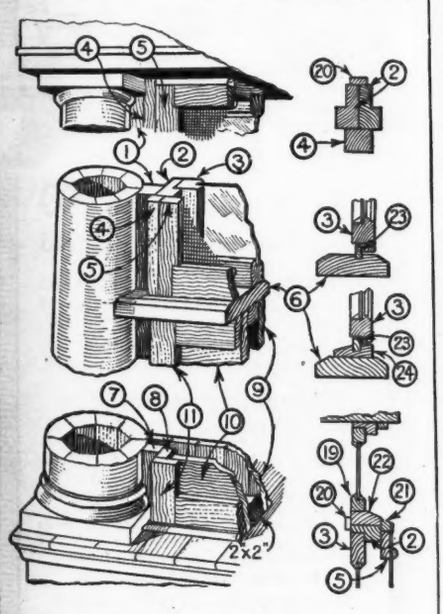

Fig. 3. A workmanlike and economical way of inclosing a porch that has round columns

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How many men do you know who surprise you by the wealth of their general information and the breadth of their knowledge? If you were to inquire, you would find that these men make a daily habit of consulting an up-to-date Encyclopaedia. Here they have the knowledge of the centuries—accessible, concisely and plainly stated, easy to grasp and to remember.

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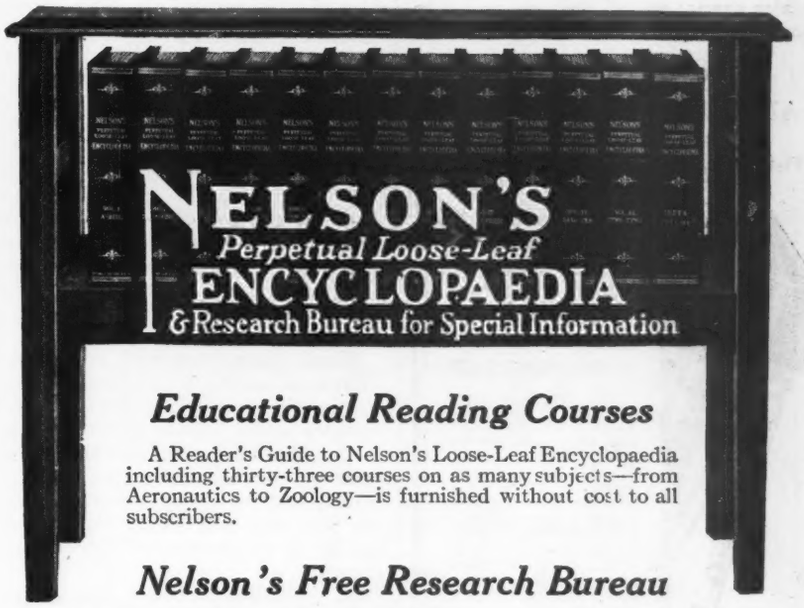

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Dependable!

METAL long has been recognized as the best of electrical conductors. The *Lynch* Metallized Resistor gives *conductive, non-arcing* resistance that means absolutely silent operation, permanent accuracy, dependability.

Leading engineers, test laboratories and experimenters have found that this fixed resistor wins in the acid tests of time and service. It marks as great an advance in its field as did the tungsten lamp over the old carbon bulb. If your dealer cannot supply you, we will ship postpaid—same day order is received.

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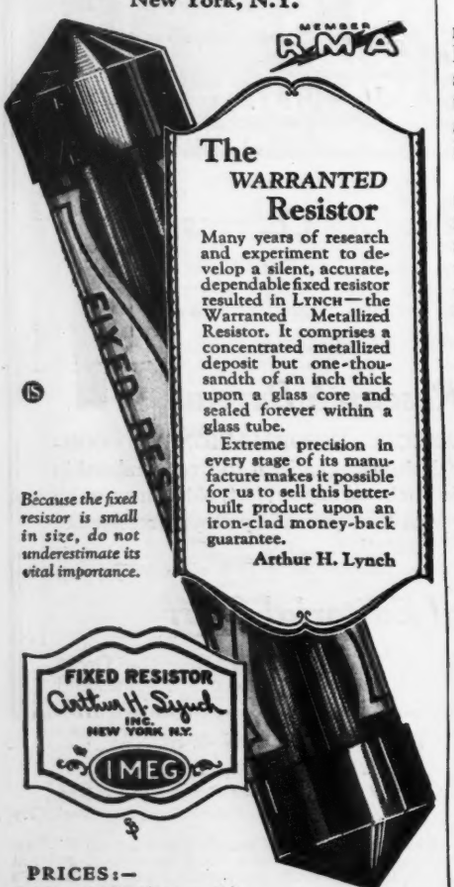

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LYNCH METALLIZED FIXED RESISTORS

The Home Workshop

Inclosing an Open Porch

(*Continued from page 111*)

to make the inside casement sash thoroughly weather tight at the bottom, they may be made as detailed in Fig. 3. The main sill, that is, the original porch rail or the piece added to it, is plowed (grooved) to allow a strip (No. 23) to be inserted, or a narrow ⅞-in. thick extra sill with such a groove (No. 24) may be added. Both methods are illustrated.

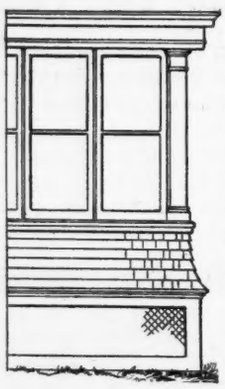

Fig. 4. Inclosed porch with square posts

To inclose a porch by the second method, which is an excellent one to follow where the old posts are not worth saving, begin by propping up the roof with a number of struts. Two by fours usually are strong enough if the roof is not of especially heavy construction. After removing all rails and posts, make a new railing framework of rough two by fours. Leave the door opening as previously suggested, for jambs or posts will have to be placed for the door or doors, as well as a transom bar for the headlight, if one is to be used.

Plumb down from each corner of the soffit or beam above and make allowance for the thickness of the shingle lath and shingles before placing the rough framework. When the posts are finally put in position, they must line up correctly. If this allowance is not figured out accurately, the post may come either too far out or too far in at the top or else be out of plumb.

Wedge out the bottom shingle lath to suit the slight curve of the bottom shingle. Place a shingle in the lowest position and measure up 6 in. from the extreme butt in order to find where the next lath should be placed. The other laths are spaced to suit, usually from 4½ to 5 in. center to center. Allow more at the top for the space taken up by the molding which goes under the rail.

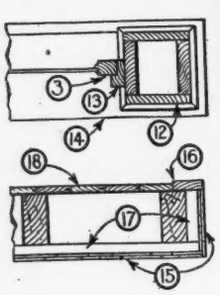

Fig. 5. Details of construction as in Fig. 4

The first row of shingles should be doubled, the joints of the outer shingles covering those in the under row. The shingle lath is shown at No. 17 (Fig. 5) and the shingles nailed to them at No. 15. The corner piece, No. 16, is 1⅛ by 4 in.; No. 18 is the ½-in. tongue-and-groove ceiling and is nailed inside the bottom section to hide the rough framework.

(*Continued on page 113*)

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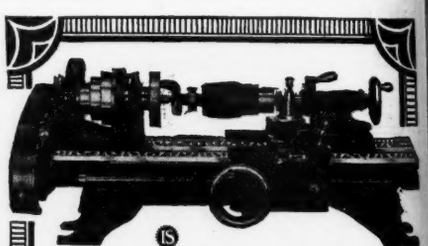

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The Home Workshop

Inclosing an Open Porch

(Continued from page 112)

The cap or rail (No. 14) must be wide enough to project over all the work so that a molding can be placed under it on each side. Boards 8 in. wide will be sufficient if the two by fours are laid with their 4-in. surface horizontal; 6 in. if the two by fours are laid with their 2-in. surfaces horizontal. The cap should be beveled slightly as shown at No. 6 in the first design.

If parts of the old posts cannot be utilized, new ones should be made to measure at least 6 in. square. Two pieces 1⅛ by 4 in. and 2 pieces 1 by 6 in. can be nailed together to make a good post (No. 12). To give the post a finished appearance at the bottom, nail ⅝ by 4-in. pieces at each side to form a base.

A rabbeted piece (No. 13) is carried up the post and across the head to receive the screens or sash. It should be 1⅛ by 2¼ in. The crown or bed molding and the neck molding are butted against this piece. This allows the screens and sash to be placed without scribing or fitting them to the moldings, which is more or less difficult to do neatly.

The sash, as shown in this design, are fastened in with buttons. In the spring, some or all of the sash are replaced with screens.

It will be seen that this plan may be modified to take both sash and screens, as in the first design.

How to make lasting repairs to a leaky shingled roof will be the subject of the next article by Mr. Elling.

At Last a Place for Rubbers

(Continued from page 74)

dilute the saturated solution with one half water. Flood the stain on, wiping off the surplus, and when dry lightly sandpaper with 00 sandpaper. Then you will be ready to fill with a dark brown paste filler. After that is dry, apply three or four coats of white shellac, rubbing each coat lightly, and the last one rub down thoroughly with 00 steel wool. If you want more gloss, rub on a furniture or floor polishing wax."

Bill of Materials for Combination Umbrella Stand

The finished size of the pieces are as follows, all dimensions being in inches:

Parts	Pieces	T.	W.	L.
Legs	4	1½	1½	32½
Lower front and back rails	2	1½	1½	17½
Lower end rails	2	1½	1½	8
Compartment back	1	⅞	5	17½
Compartment ends	2	⅞	5	8
Door	1	¾	5	17½
Top rails	2	⅞	1½	17½
Side rails	2	⅞	1½	8
Top center bar	1	¾	⅞	18⅜
Top crossbars	3	¾	⅞	8⅞
Compartment top	1	⅜	8¾	18¼
Compartment bottom	1	½	9¼	19¼

Two 1 by 1 in. butt hinges; one ¾-in. wooden drawer knob.

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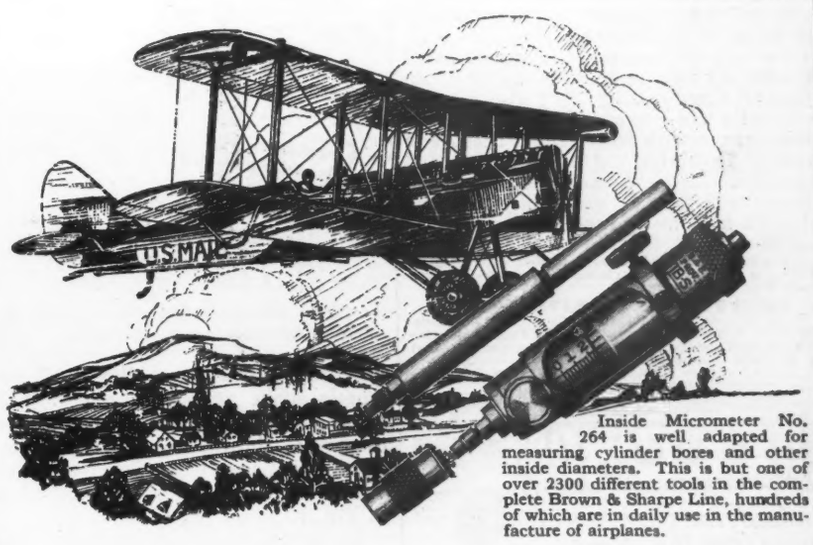

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The Home Workshop

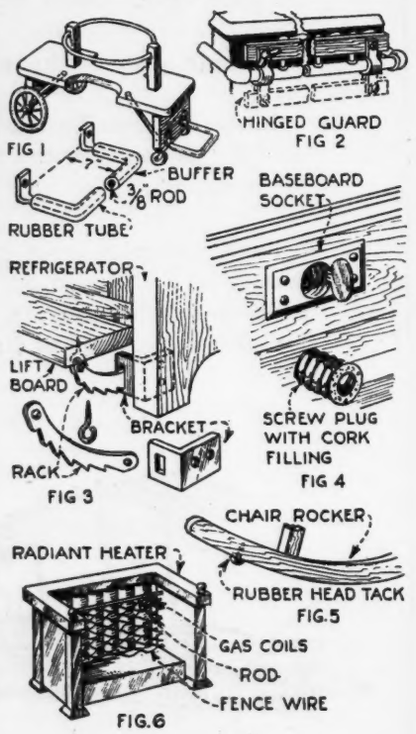
Safety First for Young Children

By F. J. Wilhelm

THREE children in my city were killed within a year by falling out of windows because of the failure of the insect screens. For these accidents there was no excuse whatever. If the screens had been properly fastened and strongly made, the children would not have fallen.

Many painful and serious accidents to children could be prevented if the parents would use as much common sense in observing safety-first practices in their homes as manufacturers are compelled to do in their factories.

Many baby creepers or walkers, especially of the cheaper kind, have a habit



Safety devices for baby walker, gas stove, ice box, baseboard socket, heater and rocker

of turning over when the small front wheels strike a door threshold. When that happens, the baby, not being able to escape, is thrown heavily on his face. Such mishaps can be avoided by fastening a bumper to the front of the car, as shown in Fig. 1.

In playing house, children will sometimes turn on the gas jets of a gas range. This is most apt to happen when the children are left home alone. To prevent any possibility of an accident from this cause, a ½ by 2 in. wooden strip can be fastened to the feed pipe, as shown in Fig. 2. This guard can be raised and made fast by tightening either one or two thumbscrews. When the gas range is in use the guard hangs down.

The usual lift door in front of an ice box water pan is a natural trap to pinch children's fingers. A *(Continued on page 115)*

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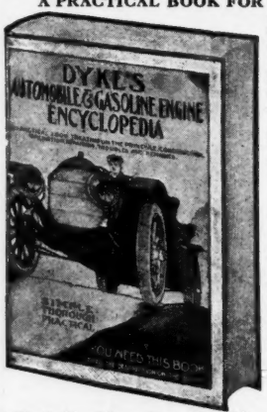

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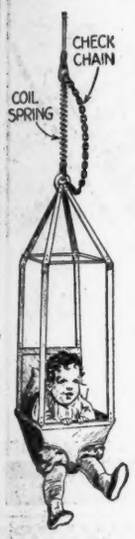
The Home Workshop

Safety for Children

(Continued from page 114)

ratchet arrangement can easily be made, as shown in Fig. 3, to prevent the board from dropping unexpectedly. This is also a convenience when the pan is to be emptied.

THE writer has seen children put their fingers in baseboard outlets used for floor lamps and vacuum cleaners. As the current usually is "on" in this type of outlet, a serious accident might occur. Some sort of plug should be kept screwed in such sockets.



Safe swing for the baby

If no other suitable plug is at hand, one can be made from a burned-out electric light bulb by removing the metal shell and filling it halfway with wax. A short wood screw is then set in and the balance filled with sealing wax so that the head of the wood screw w ll be flush with the top. This plug can be inserted with a screw driver and is a good protection as the children cannot easily remove it (Fig. 4).

Some rocking-chairs tend to tip backward when rocked violently. A large rubber-headed nail driven into the rocker, as shown in Fig. 5, will prevent this, if placed properly.

Certain types of radiant gas heaters have only a single wire rod to hold the artificial coals in place, and children sometimes will break the coal by throwing a toy at them. The heater can be made safer by inserting a section of fence wire in front of the coals. If the wire (Fig. 6) is of the type having a heavy upper strand, this can be inserted in place of the rod already on the heater. The lower end of the mesh can be bent at right angles and soldered to the heater's base.

CANVAS jumping swings, like that in Fig. 7, sometimes do not have a check chain or rope to prevent an accident if the spring breaks. This can easily be added.

Window screens should always be so well installed that the children can neither open them nor push them out. If they are outside screens, fastened at the bottom with hooks and eyes, it is well to turn the eyes at right angles to the hooks with a pair of pliers.

If the screens are of the inside type, sliding up and down on tracks, it is well to replace the wooden tracks with angle iron packed out either by means of washers or a wooden strip. A hook can be placed at the top of the screen to prevent its being raised.

The screening itself should be strong and not rusted. If there seems to be any chance of its tearing, it can be reinforced with several lengths of ⅛ in. wire screwed to the frame.

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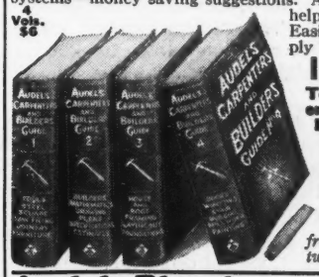

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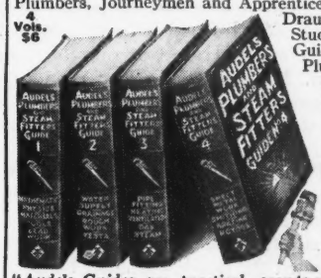

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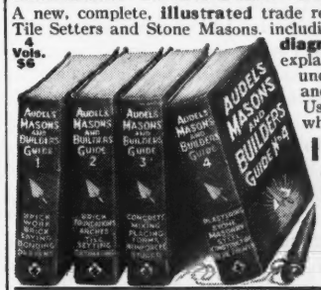

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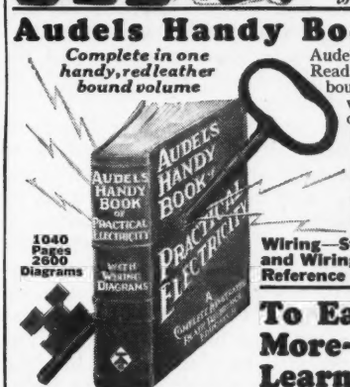

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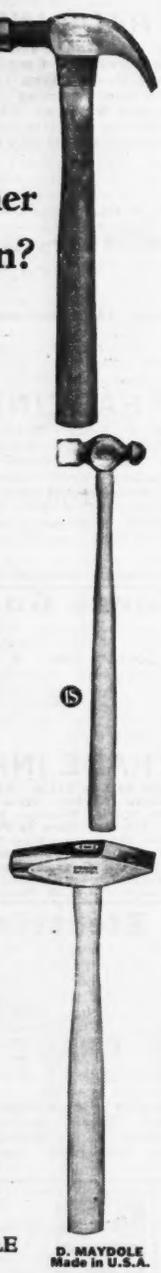

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The Home Workshop

Let's Hammer Out Some Copper Bowls

(*Continued from page 68*)

of jewelry making, and much of my knowledge of shaping the more precious metals was gained at the forge.

While I was still working in the blacksmith's shop, I spent two summers in a large boys' camp in New Hampshire as one of the masters, where I was to teach sketching and the designing required for the manual training course in woodworking. It seemed rather difficult for the boys and for me to get down to sketching in that healthy out-of-door life.

ONE of the boys found an old copper-bottomed wash boiler. Here was material for us, but we had no tools save a pair of tinner's snips borrowed from the woodworking shop.

Selecting a pleasant spot in the woods near a stream, we cut down a tree, leaving the stump about three feet tall, and sawed the top square across. Then we built a camp fire, heated one end of an old iron bar red-hot, and burned a hollow in the top of the stump. Here was our forming block (Fig. 1, page 68). The campfire also was used for annealing; any fire or torch will do if it will heat the copper to a dull red.

We had no forming hammer or mallet, so, selecting a certain branch of a beech tree, we cut a part of this off to make a natural mallet. The larger part of the branch formed the head; a smaller branch, nearly at right angles to this, made a good handle. One end of the head was rounded over by whittling.

Those who wish to try decorative metal working and have had no previous experience can easily duplicate the success we had in making those copper bowls.

THE hollow in the forming block—about 1¼ in. in diameter and from ⅜ to ½ in. in depth—should be slightly larger than the rounded end of the mallet or forming hammer used for the bossing or doming up, which is sometimes called "bowl raising." Bowls of practically any size may be made over the same hollow, as the diameter of the hollow and the diameter of the bowl have nothing to do with each other.

If the water used in the annealing process contains about ten per cent of either nitric or sulphuric acid, it is then called "pickle," and its action is such that all scale produced by the fire is removed so that the copper may be scrubbed bright and clean. When making pickle, *always pour in the water first* and then *slowly add acid*. However, the bowl will be just as soft if, after being heated a dull red-hot, it is quenched in plain water, but the copper will remain dark. The fire really does the softening; the water cools it; the acid cleans it.

Number 20 soft rolled copper is an excellent weight for this purpose. The heavier weights or gages are rather stiff for the light tools described here.

To cut out a circular disk from a sheet of copper, scribe on (*Continued on page 117*)

Three Times and a Friend for Life

Try Barbasol just three times—according to directions. You'll never use anything else for shaving. No brush. No rub-in. No after-smart. 35c and 65c tubes.

The Barbasol Co. Indianapolis Ind.

I enclose 10c. Please send trial tube.

Name.....

Address.....

.....

P-S-M-10-26

For Modern Shaving

Bradleyleak

THE PERFECT GRID LEAK

Provides a noiseless range of grid leak resistance from ¼ to 10 megohms. Assures most effective grid leak resistance value for *all* tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

Allen-Bradley Co.

Electric Controlling Apparatus

293 Greenfield Avenue Milwaukee, Wis.

$5 Down

Buys Any WITTE Engine From 1½ to 7 H-P.—No Interest Charges

The Ideal Farm Engine for Pumping and All Farm Chores. The One-Profit Engine—Sold Direct To You From Factory On Your Own Terms.

Develops Full Power on KEROSENE, GAS-OIL, GASOLINE, DISTILLATE or GAS. Simple economical and trouble-proof. Equipped with WICO Magneto, square, protected tank, die-cast bearings, speed and power regulator and throttling governor. ALL SIZES 1½ to 30 H-P.

FREE Write today for big, Free Catalog and Low Prices. Or, if interested, ask about Log and Tree Saws, 3-in-1 Saw Rigs or Pump Outfits.

WITTE ENGINE WORKS

2221 Witte Building, KANSAS CITY, MO.
2221 Empire Bldg., PITTSBURGH, PA.
2221 Witte Bldg., SAN FRANCISCO, CAL.

Quick shipments also made from nearest of 25 warehouses.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

The Home Workshop

Let's Hammer Out Some Copper Bowls

(Continued from page 116)

the circle with dividers. Then cut out a square just inclosing the circle. Cut off each corner of this square almost up to the circle and finally trim the metal to the line.

When your copper disk has been cut out and annealed by heating it red-hot and quenching it in water or pickle, place it over the forming block. Start hammering with the curved end of the mallet so that the first blows come exactly in the center of the disk, over the hollow underneath. Then move the bowl slightly to one side of the center and hammer around the hollow depression you made first, thus working from the center gradually out toward the edge of the disk (Fig. 3). Hammer in concentric circles, round and round, until you work out to the very edge.

IN FIG. 4 are shown the various stages of shaping a shallow copper bowl. The bowl is annealed after the surface is hammered over each time.

A simple method of making a base is shown in Fig. 2. The bowl is turned upside down on the bench and a circle lightly scribed on the bottom in the center. The curved end of the mallet is then used to drive the copper down inside of the circle. The hammering is started in the center.

Bowl makers usually plan their work so that the bowl is well hammered after the last annealing to leave it stiff.

The wooden forming mallet should be about 1½ in. in diameter with a head about 4 in. long. The forming block may be either a stump or a block of hard wood held in the vise.

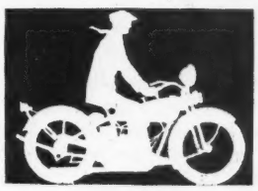
The bowl may be colored if it is first "pickled" and scrubbed bright and clean with pumice powder. Coat it with turpentine or machine oil and bake it in an oven, taking care not to burn off the oil with too high a temperature. Iridescent colors are produced in this way, or, if the baking is continued long enough, a brown or gray will result.

GREEN may be produced by having the bowl perfectly bright and clean, dipping it in the pickle, and setting it in the sunlight for several days. It should be remembered that the green so produced is very poisonous, particularly in a cut. The bowl's surface, therefore, should be covered at once with floor wax, clear lacquer, or varnish.

Another method of coloring copper is to use a piece of liver of sulphur (Pentasulphide of Potassium) dissolved in hot water, a piece about the size of a hickory nut to a quart of water. The clean copper is dipped in this solution and then immediately rinsed in cold water. This same solution is used to oxidize silver.

In the next installment of his adventures in toolcraft, Mr. Thatcher will tell how he set up a most complete and practical home workshop in a 4 by 7 ft. room in a New York apartment.

Street Car–1 Hour



Single 20 Min.

Pays for Itself –in Time Saved!

HERE is the new-day means of rapid travel at lowest cost. Direct—safe—convenient—comfortable!

Ride the Single to work—and save at least an hour each way. Ride it on errands—and park it in any 2x8 ft. space. Ride it into the country—and enjoy traveling as you never have before. All at a cost of only *one cent per mile!*

Easier to ride and control than a bicycle—safe. As dependable as cars costing five times as much. *Easy to buy.* Your dealer offers a convenient Pay-As-You-Ride Plan. See him today.

Price, complete with 3-speed transmission and full electric equipment, f. o. b. Milwaukee, is $235

HARLEY-DAVIDSON MOTOR CO.
Dept. PS. Milwaukee, Wis.

The HARLEY-DAVIDSON [New-Type Motorcycle] Single

80 miles per gallon

Easy to Ride

Comfortable

Safe

Mail the Coupon

Harley-Davidson Motor Company
Dept. PS. Milwaukee, Wis.

☐ Interested in your Single; send catalog and my Dealer's name.
☐ Interested in your dealer proposition. Is my territory open?

Name _____

Address _____

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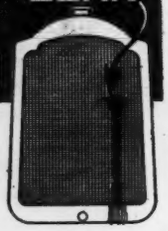
STOP THAT LEAK WITH SMOOTH-ON No. 1



You can apply Smooth-On with radiator full or empty, hot or cold, without removal from the car and without putting inside anything that clogs the circulation.

Merely roll the Smooth-On into a stiff putty, press it against and into the leak with your thumb or pack it into the defect with a knife blade or screwdriver, and scrape off the excess. The leak will stop instantly, and the repair is permanent. For a few cents and in a few minutes you will have avoided all the delays and expense of a professional repair job that couldn't be any better.

Bursted water jackets. Water jackets of automobile, stationary or marine gas engines which have developed long or short cracks or have even had pieces broken entirely out from freezing can be made thoroughly and lastingly serviceable by similar repair, or by applying Smooth-On under straps or a plate.

Smooth-On No. 1 can be used in a hundred ways in the household, and it often saves from $50.00 to $100.00 on the first job.

Keep a can of Smooth-On No. 1 with your tool kit and some day when caught with a repair job you will thank yourself for your forethought.

Smooth-On Mfg. Co.
Dept. 58
574 Communipaw Ave. Jersey City, N. J.

Write for FREE BOOK

Get Smooth-On No. 1 in 7 oz., 1-lb. or 5-lb. tins at nearest hardware store or if necessary direct from us.

FREE

This booklet tells how to stop not only water leaks in radiators, bursted water jackets and at loose hose connections, but also how to stop gas leaks from the tank, gasoline lines and exhaust system, and oil leaks at gaskets and at cracks in crank or gear case. It also tells how to make headlight posts, nuts, hub caps and bolts and grease cups stay tight, and shows dozens of simple money saving Smooth-On repair jobs. *Sent free if you return the coupon.*

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO. Dept. 58,
574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name.....

Address.....

.....

Return this coupon for FREE copy of Booklet

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

ONE of the most useful chemicals in the home workshop is benzol, a comparatively inexpensive, light, mobile liquid, which can be obtained at the larger paint stores, drug stores or chemical supply houses. It is rather inflammable, burns with a smoky flame, and boils at 81 C. or 177 F. It mixes readily with alcohol, ether and aceton, but not with water. It must be kept away from flames.

Benzol is used as a solvent for resins, fats, rubber, sulphur, phosphorus and iodine. If stains of any of these substances are to be removed, moisten the stain with benzol on a rag and rub. If the stain is stubborn, soak the spot in a small dish of benzol until the material has softened and then remove the stain with a clean rag or a piece of blotting paper. This is one of the methods used by dry cleaners for the removal of such blemishes.

Dissolving lumps of asphaltum in benzol

Benzol serves in an emergency for reconditioning old and unfit varnishes. Even the skins of a dried-out varnish may be reclaimed and made into a new varnish, which, when dry, will have characteristics similar to those of the original varnish.

Such scraps and dried skins of old varnish are dissolved by adding the benzol in sufficient quantities to make an easily flowing liquid. Allow the mixture to stand for a few hours. The resulting varnish will be more or less elastic and hard and will dry quite rapidly. It will have excellent waterproofing properties and may be used for toys and other work that does not warrant the use of an expensive varnish.

A varnish for metal is prepared by dissolving sufficient asphaltum in benzol to make a solution of creamy consistency. The addition of a teaspoonful of boiled linseed oil to an ounce, or one ounce of the oil to about one half pint of asphaltum varnish makes a more durable and flexible varnish, useful both on metals and on glass.

For your convenience, the following label has been prepared for pasting on the benzol container.

Benzol

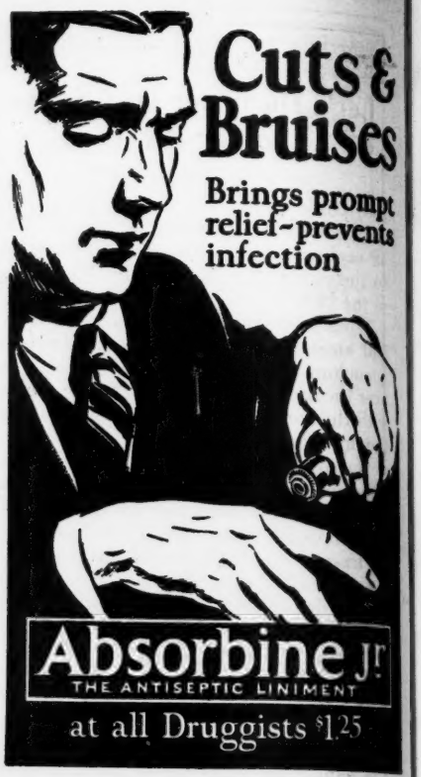
(*Also known as Benzene, not Benzine*) C_6H_6

Keep in tightly corked bottles. Never expose to flames. It is quite volatile and burns readily.

As a dry cleaner it removes stains left by fat and varnishes.

It dissolves thickened varnish and varnish skins and converts them into varnishes that have waterproofing properties and are suitable for a common grade of work.

It dissolves asphaltum and forms a varnish for iron and glass.



Will we fly to the Moon in 1986?

Who knows! New developments in airplanes and startling feats in the air are coming so fast no one can say it is impossible. Find out how these marvelous machines are built; how they operate. **Build a Flying Model of your own.** It's an instructive and interesting hobby for every man or boy. Ideal Plans (Drawn-to-Scale) and Building-Flying Instructions show you how to build and fly accurate 3 ft. Models of any one of the following famous 'planes. Send now for the set you want.

JN Type--Curtiss Training Plane
DH Type--DeHavilland World Flyer
N C 4--Naval Seaplane
Bleriot, Nieuport or Taube Monoplane
Cecil Peoli Racer

Plans and Instructions 25c per set postpaid (7 sets $1.25)

48 pp. Catalog of Model Airplanes, Parts and Supplies--5c pp.

Ideal Aeroplane & Supply Co.
163-165 Spring Street, New York

A 2c Stamp

—will start you on the road to success. See Money Making Opportunities on pages 136 to 165.

FREE—OUR 84-PAGE CATALOGUE, FILLED WITH RADIO BARGAINS. WRITE TODAY!
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 3 CHICAGO, ILL.

SAY! LISTEN!

A NEW PAIR OF PANTS MATCHED TO YOUR COAT AND VEST. Just doubles the life of your suit. We can match almost any suit. 70,000 patterns. Sample is sent for your O. K. before making. All made to measure. Send piece of cloth or vest for matching.

ACME PANTS MATCHERS
Dept. A12, 20 W. Jackson, Chicago
Enclose return postage if vest is sent

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The Shipshape Home

An Expert Answers Your Paint and Varnish Questions

WHEN you have a question on any subject relating to the use of paint and varnish in keeping your home shipshape, you usually ask your hardware or paint dealer for help. That has made it possible to find out from various dealers what are the ten paint and varnish problems most fre uently encountered by amateur painters.

The hardware and paint store is, indeed, a barometer of what the people in any locality use in paints and varnishes. Ten hardware stores—five located in various downtown and residential sections of one of the large cities, and five in

Amateur painters ask their paint dealers many questions, of which the ten most common are answered in this article

small cities and little villages—will fairly represent the paint and varnish requirements of the country as a whole. The questions most frequently asked these dealers will represent the problems of the majority of paint and varnish users.

Here are the questions, together with brief answers: (Two very common questions are excluded, as they obviously cannot be answered on these pages—"Which is best for outside painting, prepared paint or lead and oil?" and "Which brand is the best?")

1. How much paint will it take to paint my house?

This may be estimated by measuring the distance around all four sides and multiplying by the average height, which gives the square feet. Divide this by the covering capacity of the paint used—generally considered as about 300 sq. ft. (2 coats) to the gallon for prepared paint. This, however, (*Continued on page 120*)

A-B & C Light Socket Radio Power

for any set - new or old

Now all Radio Power is in your light socket. A. & C. Kodel Transifiers replace all batteries. Just plug in the wall socket and smooth A, B and C current flows to your receiver—gives new pep, new life to any set—longer range, greater volume. Transifiers create an altogether new standard of really fine reception.

Kodel A&B Transifiers

Are vastly different and superior to so called power units. Transifiers consume current only while you operate the set. Much lower maintenance cost. Less than one half cent per hour to operate both A and B Transifiers. You may purchase both A and B or either model separately from your radio dealer.

MODEL 10 "A" TRANSIFIER	MODEL 61 "B" TRANSIFIER	MODEL 10 "E" TRANSIFIER
Supplies constant 2, 4, or 6 volts "A" power to sets using up to 10 tubes. Absolutely no hum, noise or interference.	Smooth, powerful, noiseless "B" current for sets up to 6 tubes. 22½ to 90 volts.	22½ to 150 volts "B" power, 4 to 10 volts "G" power. Constant uniform current to supply any size set. Will operate power tubes.
Price without bulb $42.50	Price without bulb $28.50	Price without bulb $42.50

"Behind the Scenes in a Broadcasting Station", an interesting, 24-page booklet, together with literature describing Kodel A and B Transifiers, will be mailed free on request.

DEALERS: Write for particulars on Kodel Radio power devices.

THE KODEL RADIO CORPORATION, 500 EAST PEARL ST. CINCINNATI, O., U. S. A.

Owners and Operators of Broadcasting Station WKRC

Battery Chargers Power Units **KODEL** *Radio Receivers Loud Speakers*

POWER SPECIALISTS SINCE 1912

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CORONA

THE PERSONAL WRITING MACHINE

IN AN HOUR, WITH CORONA, you can clean up the fag end of a day — and every word you write is clear, legible, neat.

If you haven't a Corona in your home, ask the local Corona dealer to see our standard keyboard model; or just clip the coupon below.

CORONA *has all these modern features:*

The keyboard has four rows of keys—the same as office typewriters. You don't have to shift for figures.

Instead of a six-yard ribbon, Corona's automatically reversing two-color ribbon is twelve yards long.

The large self-spacing carriage return lever is right up where you want it for quick action. Corona is the only portable with a real variable line spacer. There is also a convenient stencilling device.

Corona has a shift key on each side. Back spacer and margin release are conveniently located on the keyboard.

You can see what you are writing without moving your head an inch. The visibility is perfect—and at right angles to vision.

The type bar action operates on exactly the same principle as that employed on all the best full-size machines—the type comes up to strike the paper.

The full-width carriage takes a No. 10 envelope—just like any office machine.

Over 700,000 Coronas, more than all other makes of portables combined, prove Corona's durability.

MODELS AND PRICES

The price of this standard keyboard Corona is $60 with case. Other models at $50. Special keyboards available for all foreign languages and technical writing. Dealers will accept used typewriters as part payment.

Mail this today

L C Smith & Corona Typewriters Inc
718 E. Washington St., Syracuse, N. Y.

Without obligation to me, please send me latest information about Corona.

Name .....

Address .....

.....

The Shipshape Home

Your Paint Questions

(*Continued from page 119*)

is only approximate, as some makes of paint cover more surface than others, and conditions of the surface differ.

Where lead and oil are used, 100 lbs. white lead, 4½ gals. linseed oil, 1 qt. turpentine and 1 qt. drier will make about 8 gals. of mixture capable of covering 300 sq. ft. (2 coats) to the gallon (when the priming coat is properly thinned). This also is only approximate.

Allowances should be made for gables, bays and other projections. For the trim, cornices, and so forth, about one-sixth as much paint is required as is needed for the body.

2. How much material will it take to paint, varnish, stain or enamel a room?

Ascertain the square feet of surface. Divide this by the covering capacity of the material used. In estimating the area of ceilings or floors, simply multiply the length by the width. For walls, multiply the distance around the room by the height, and subtract 15 sq. ft. for each average sized window and 21 sq. ft. for each average door. For standing woodwork, the doors will average 21 sq. ft. each; window casing and sash about 10 sq. ft., and baseboard about 2 sq. ft. per running yard, but all may readily be measured exactly.

Flat wall paint, as a rule, covers about 300 sq. ft. (2 coats) to the gallon on hard, smooth plaster, about 250 sq. ft. on rough or very porous plaster, and about 350 sq. ft. over previously painted walls.

Stain usually will do from 500 to 600 sq. ft. (1 coat) to the gallon. Enamel and enamel undercoater will ordinarily do about 350 to 400 sq. ft. (1 coat) to the gallon. These figures are based on average surfaces and average conditions.

3. How should I enamel the bath room woodwork white?

If it is to be done over a previously enameled finish, simply sandpaper the surface to cut the gloss and apply one coat of enamel; if necessary, apply two coats, sandpapering between coats. If over new woodwork or previously varnished woodwork, build up a foundation with flat undercoater. The following produces a good finish: First coat, undercoater; second coat, half undercoater and half enamel; third coat, straight enamel. If found necessary, apply another coat of full enamel.

4. What should I use to paint the kitchen and bath room walls?

Kitchen walls are subjected to such greasy fumes and deposits from cooking that regular flat wall paint becomes soiled quickly and is difficult to clean without streaking. Semi-gloss wall paints are to be preferred. Where these are not available ready prepared, a very pleasing semi-gloss finish can be obtained by mixing equal parts of flat wall paint and varnish. Many also like a full enamel finish, the porcelain-like surface of which may be most easily cleaned. (*Continued on page 121*)

Ingersoll

PRICES REDUCED

The New YANKEE
Now $1.50

Reduction Applies to Entire Line

Douglas MacLean says: "You can't beat a Lyon & Healy saxophone for tone or for ease of playing!"

"I've heard 'em all and I can tell the difference with one ear. The Lyon & Healy is *some* sax!" Doug's own words.

Douglas MacLean, Famous Players film star is an amateur musician—but he knows real music when he hears it. He has found, too, the secret of popularity—knowing how to do things! Like Doug, you will find our simplified instrument easy to finger, easy to play clear, loud and mellow. The choice of professional musicians, also, because of its perfect pitch, accurate adjustment, beautiful finish.

Discover for yourself the advantages of our special "Easy to pay while you play" plan by mailing the coupon today. Positively, friends, fun, money are yours when you buy a Lyon & Healy Saxophone. Let us help you learn quickly, easily. But act now!

LYON & HEALY
59 E. Jackson Blvd. Chicago, Ill.
Everything known in Music

The real facts about saxophone playing, its opportunities for pleasure and profit are told frankly in this fascinating, illustrated book. Send for your FREE copy today!

FREE! Mail the coupon to day!

LYON & HEALY, Inc. *Factory Sales Division*
59 East Jackson Blvd., Chicago.
Please send me FREE, your remarkable new Saxophone Book, and full details of your special "Easy to pay while you play" offer.

Name .....

Address .....

City ..... State .....

HUNDREDS OF AGENTS

Pocket $110 A Week With Amazing New Cap

New adjustable feature makes Fits-U Caps fit any head instantly. A perfect fit always. 36 snappy style-color combinations. Finest hand tailored workmanship. Amazingly low price. Every man and young man wants one of these new stylish caps. All you do is take orders. No experience necessary. Big commissions daily in advance.

Selling Outfit FREE

Hundreds of others make $110 a week showing this wonderful Fits-U Adjustable Cap. We furnish complete selling outfit FREE. Write immediately for it—also for full details about the FREE cap we give you.

FITS-U CAP CO., Dept. SM-10, Cincinnati, O.

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The Shipshape Home

Your Paint Questions

(*Continued from page 120*)

For bathroom walls, flat wall paint gives satisfactory service for a reasonable length of time, but a semi-gloss or enamel finish will keep looking well for a longer period of time.

5. How should I refinish my floors?

If in good condition, simply scrub out all dirt, sandpaper to cut the gloss, and apply one or two coats of floor varnish.

If worn clear down to the wood and discolored to a grayish, weather-beaten color in spots, these places should be bleached with a strong solution of oxalic acid and boiling water. Paste filler then should be applied. Cracks, if any, should be filled with the paste filler or with a regular crack filling preparation. If there is an apparent difference in color between the worn spots and the rest of the floor, a coat of varnish-stain should be applied to these places of the proper shade to bring them up to the color of the rest of the floor. Then one or two coats of clear varnish should be applied over the entire floor. The addition of a small amount of varnish-stain to the clear varnish (not over a quarter-pint to a quart of varnish) will color the varnish slightly and tend to hide any slight variations in color.

6. How do you refinish a table (or other piece of furniture)?

This is a query that usually requires some questioning on the part of the paint man to bring out just what is wanted.

Suppose a table finished in golden oak is to be done over in a walnut finish. The only way to produce a job that will equal the original finish is to take off the old coating to the bare wood, and build up a new finish, using the same methods used in the furniture factory. A very satisfactory job can be produced, however, by sandpapering the old coating and applying a coat of walnut varnish stain, followed by a coat of clear varnish, either gloss or dull finish.

Perhaps a table that is badly checked has to be refinished. When a varnish finish has checked (developed a network of small cracks) there is no way to eliminate the checks without taking off the old coating. Nevertheless, they can be rendered much less noticeable by sandpapering the surface well and applying two coats of varnish. The varnish must be rubbed down with fine sandpaper between coats. The first coat fills the checks to some extent, although it tends to magnify them at the same time. The second coat obscures the filled checks. The second coat may be either flat (dull finish) varnish, or gloss varnish.

7. What type of paint should I use for metal?

House paint can be used directly on all metal surfaces, with the exception of galvanized iron, which is of a greasy nature and must first be coated with a special galvanized-iron primer. There are, however, metal protective paints on the market that are preferable (*Continued on page 122*)

Turned Down Again

—perhaps it's *comedones**

NOT a single dance with her. How he envied the other men as they gaily whirled her 'round the floor! Somehow *he* was always "just too late." He suspected she was purposely declining his invitations. But, never for a moment did he guess that the reason was . . . comedones.

A great many young men suffer from comedones . . . commonly called blackheads. Skin can't be clean-looking, fresh, wholesome, if these disfiguring formations are present.

What's more, you may not even be conscious of *comedones*. But your friends notice them. You may wonder why invitations become fewer —why friends—girls in particular —seem to avoid you. You may never guess. Perhaps it's *comedones*.

Pompeian Massage Cream helps you overcome comedones. It gives you a clean, clear, ruddy complexion. It gets into the pores where comedones form, rolls out all dirt and oily secretions, and stimulates a healthy circulation, keeping skin clean, pores open.

Try this treatment

After you shave, spread Pompeian Massage Cream generously over your face—and *rub*. Continue to rub until the cream rolls out. Note how dark the cream looks. That's the dirt that was in your pores. No need to have a dirty skin. Don't let comedones form. Use Pompeian Massage Cream every day. It means a healthy, wholesome skin. It means more joy in living.

Use at Home after shaving

To get full pleasure and benefit, use Pompeian Massage Cream regularly at home after shaving. Your face will feel and look like a million dollars. For sale at all drug stores.

*WHAT ARE COMEDONES? (pronounced cŏm'e-dōnes)
(*Dictionary definition*)

A small plug or mass including the excretory duct of a sebaceous gland, occurring frequently upon the face, especially the nose, and consisting of retained semi-liquid glandular secretion or sebum. The outer end is often dark or black, due to accumulation of dust and dirt; hence it is often called blackhead.

SPECIAL INTRODUCTORY OFFER
⅓ of a 60c jar—for only 10c

For 10c we will send a special trial tube containing one-third of contents of a regular 60c jar of Pompeian Massage Cream. Trial tube contains sufficient cream for many delightful massages. Positively only one trial tube to a family on this exceptional offer. Use the coupon now.

Cut off, sign and send

THE POMPEIAN LABORATORIES
Dept. 52, Cleveland, Ohio

Gentlemen: I enclose a dime (10c) for a special trial tube of Massage Cream containing ⅓ of a 60c jar.

Name.....

Street Address.....

City.....State.....

He puts the PEP in the party

He's indispensable! this popular fellow who puts the pep in the party with his sweet singing

BUESCHER
True Tone Saxophone

You, too, have a natural desire to produce music. "Oh! If I could only play some instrument" you have said to yourself. Then you have thought of long hours of practicing scales, with possible failure in the end, and you have been afraid to try. Listen!

You Can Teach Yourself

If you can whistle a tune, if you can beat time, you can learn to play the Buescher Saxophone, Easily! You can teach yourself, at home, in a few evenings. Three simple lessons given on request with each new Saxophone start you. You learn scales in an hour and start playing tunes in a week. Your progress will astonish and delight you and surprise your friends.

Try Before Buying. Easy Terms

Take home with you any Buescher instrument, Trombone, Cornet, Trumpet, Saxophone for six days' trial. Test it. See what you can do with it. If you like it, pay a little each month. Play as you Pay. Satisfaction guaranteed. Send for beautiful free catalog of any instrument and details of trial and payment plans. No obligation. Do this today.

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
1730 Buescher Block Elkhart, Indiana

free BOOK

The Story of the SAXOPHONE

Gives complete history and tells why the Buescher is so easy to learn to play. In it you will find the first lesson chart. You must have this fine book.

Clip the Coupon NOW!

BUESCHER BAND INSTRUMENT CO. 306A
1730 Buescher Block, Elkhart, Indiana.
Gentlemen: Without obligating me in any way please send me your free literature. I am interested in the instrument checked below.
Saxophone☐ Cornet☐ Trumpet☐ Trombone☐ Tuba☐
Mention any other.....
Name.....
Address.....

The Shipshape Home

Your Paint Questions

(Continued from page 121)

when they can be obtained. Flat wall paint can be used on radiators and heated metal surfaces with good results.

8. What kind of paint should I use on stucco and concrete buildings?

Specially prepared concrete building paints are made for this. One of the principal requirements is an exceptionally large amount of liquid vehicle (oil and turpentine) on account of the extremely porous nature of these surfaces. First, the surface must be entirely free from dirt and particles of sand. Second, any salts or efflorescence should be scraped off. Third, the surface should be washed with a solution of zinc sulphate and water, mixed in the proportion of 3 lbs. zinc sulphate to 1 gal. water. This should be allowed to stand three or four days after application to give the water in the solution a chance to dry out, as the surface must be thoroughly dry when the paint is applied.

9. What should I use on concrete floors?

Concrete floor paint is made ready for use. The first coat should carry a large amount of turpentine to satisfy the absorption demands or be mixed with a varnish mixing size to seal the porous surface.

10. How is a dull finish produced?

The finest dull finishes are produced by rubbing with pumice stone and oil. This is a slow and, therefore, costly process, and the majority of dull finish effects today are produced with flat varnishes. These are applied the same way as any other varnish. Unlike most varnishes, however, the can should be shaken vigorously, or the material stirred just before using, as the flatting ingredient has a tendency to settle.

The most beautiful effects are produced when the flat varnish is applied over a full lustrous coat of gloss varnish. The finish may be varied from dead flat to semi-dull by the addition of a small amount of gloss varnish to the flat varnish. —BERTON ELLIOT.

Next month—the wonders you can work with colored enamels.

Rubber Feet for Scales

OUR family scale caused numerous scratches on a few tables upon which it was used before I prevented further damage by fastening four pieces of bicycle tire tread to two wooden blocks and screwing the blocks beneath the bottom as shown.—H. A. GUSTAFSON.

Better Flashlights

BURGESS flashlights and batteries provide a most economical service for night-time emergencies, when to be without safe, controlled light may mean serious accidents, delay and certainly much inconvenience.

You will find many sizes and designs in the Burgess selection. Handsome metal or fibre cases, short-circuit proof and dependable in all weather.

Burgess Flashlight Batteries fit all makes of flashlight cases and their service reflects the same craftsmanship and skill which has earned world-wide recognition for the Burgess Radio Batteries.

BURGESS BATTERY COMPANY
GENERAL SALES OFFICE: CHICAGO
Canadian Factories and Offices:
Niagara Falls and Winnipeg

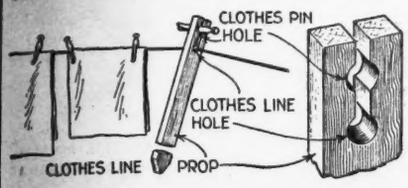
BURGESS
FLASHLIGHTS &
BATTERIES

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS.

The Shipshape Home

Prop for a Clothesline

CLOTHESLINE props of the common homemade variety, with a V-shaped notch in the top, have a habit of slipping and allowing the wash to sag. To avoid this, it is merely necessary to bore two holes at the top of the prop and



A clothespin is pressed into the upper hole to prevent the clothesline from slipping out

make two saw cuts through them as shown. When the prop engages the line, a clothespin is slipped through the upper hole to prevent the line from slipping out.—MARGUERITE B. SPREEN.

Rack for Moldings

THE HOME worker who does much woodwork has difficulty in keeping his cellar shipshape. An aid in doing this for the man who is always undertaking odd jobs around the house is the molding rack constructed as shown. It requires only two boards for uprights and odds and ends of scrap lumber. On it may be stored moldings and miscellaneous pieces of small dimensions. Everything is kept visible, accessible and orderly by this very simple and easily made arrangement.—R. M. S.

For holding your usable odds and ends of wood

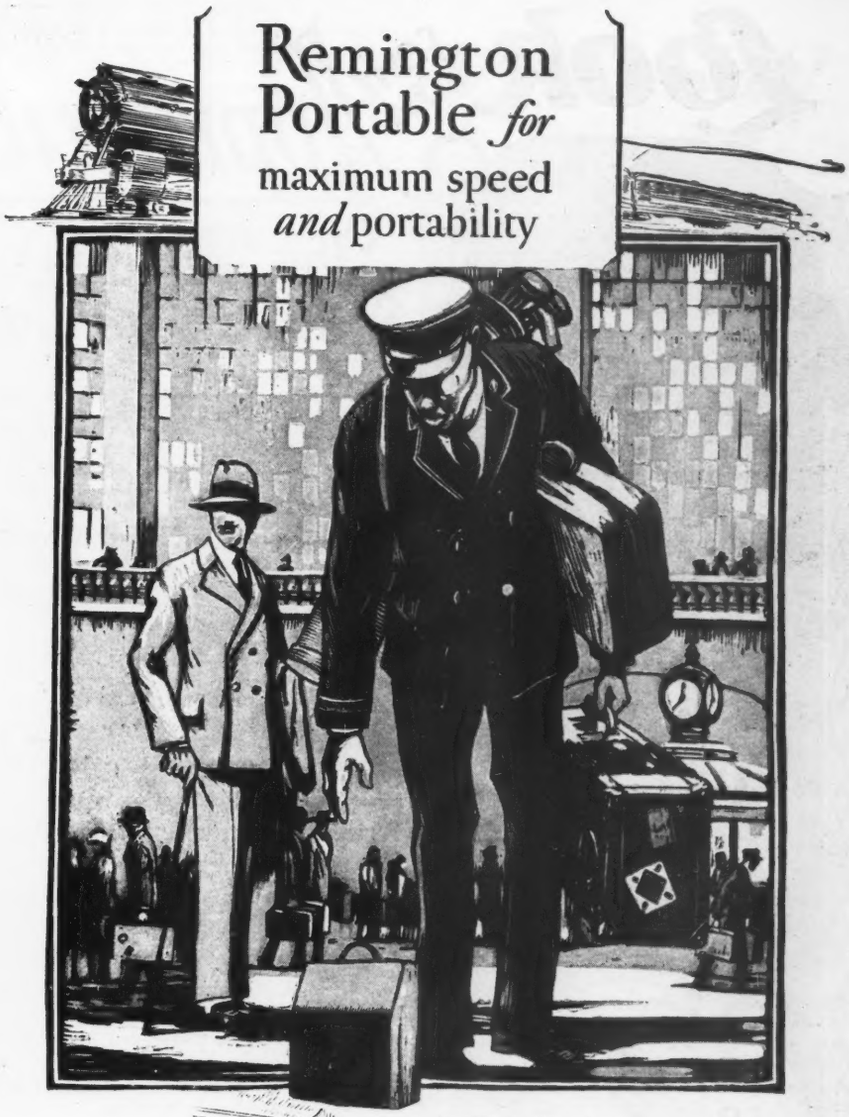
Repairing Heating Wires

BROKEN heating wires in electric toasters, stoves and similar appliances often may be repaired simply by gripping the ends between two washers, which are held together by a small bolt. Bolt and washers small enough for this purpose can be found in toy structural steel sets which, by the way, often will furnish repair parts for work about the house, when they are needed in a hurry.—W. J. E.

The broken ends are thus bolted together

TO IMPROVE badly worn cork linoleum, scrub it with warm water and a mild scouring powder and, before the surface dries, rub thoroughly with medium steel wool. Then apply two coats of floor varnish or wax.

Remington Portable *for* maximum speed *and* portability



THE Remington Portable is faster than human fingers. It is ready to work anywhere—everywhere. It is a born traveler. Small, light, unobtrusive, it is today a necessary part of the equipment of those who travel—for business or pleasure.

Take the Remington Portable with you wherever you go. It is the smallest and lightest portable typewriter with four-row standard keyboard. It has the greatest capacity for work. It is incomparable for strength and durability. It is the recognized leader—in sales and popularity.

Send for our booklet, "For You—For Everybody," to Department 67.

Remington Portable can be purchased on terms as low as $5 monthly.

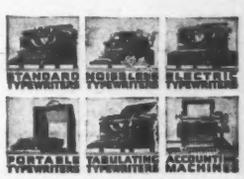
Weighs 8½ pounds net

Carrying case only 4 inches high

Remington Typewriter Company
374 Broadway, New York
Branches and Dealers Everywhere
Remington Typewriter Company of Canada, Limited
68 King Street, West, Toronto

Remington TYPEWRITERS

A Machine for Every Purpose



Remington-made Paragon Ribbons and Red Seal Carbon Papers always make good impressions

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Look Sent on Approval

Adjusted to the Second; Adjusted to Temperature; Adjusted to Isochronism; Adjusted to Positions; 21 Ruby and Sapphire Jewels; 25-year Gold Strata Case; Your choice of Dials (Including Montgomery R. R. Dial); New Ideas in Thin Cases.

The 21 Jewel Santa Fe Special

We will send this famous watch, express prepaid, for you to examine, to inspect, to admire, to approve without one penny advance payment. Examine the watch and be convinced it's the best watch buy you ever saw. Just a small payment down, the balance in easy MONTHLY payments. You use the watch while paying for it.

Save 1-3 to 1-2 of Your Money

By purchasing this Famous Santa Fe Special Watch. Not only are you saving money from the present day prices of watches, but you can still secure the "Santa Fe Special" Watch at the same low prices and terms that have made our watches famous.

Ladies' Wrist Watches

Artistic, dependable ladies' wrist watches—perfect timepieces, beautiful hand-engraved cases in white or green gold. Send for New Watch Book and see the new shapes and designs. Sent on approval and sold on payments.

Write for "Santa Fe" Watch Book

Clip the coupon, fill out and receive the FREE WATCH BOOK just off the press. All the newest watch case designs in white or green gold, fancy shapes and thin models are shown. Read our easy payment offer. Wear the watch 30 days FREE. Watch sent for your examination and approval without a penny down. Nothing to risk. See the watch before you buy.

Write for New Book Today and Select Your Watch. Mail Coupon.

Santa Fe Watch Company
A-80 Thomas Building,
Topeka, Kansas
(Home of the Great Santa Fe Railway)

FREE **A Limited Offer!** With every Santa Fe Special, a beautiful gold chain or strand of exquisite pearls. Write while offer lasts.

FREE BOOK COUPON

Santa Fe Watch Company,
A-80 Thomas Building, Topeka, Kansas.

Please send prepaid and without obligation your New Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

Name.....
Address.....
State.....

Better Shop Methods

Old Bill says—

Old Bill, machine shop foreman

A COLD chisel, hammer and file are tools enough to test a man's mechanical ability. Observe how he grinds the chisel, holds the file, and swings the hammer.

The ability to adapt himself quickly to varied conditions and circumstances is another indication of a first-class workman.

Good mechanics, too, never grumble about the shop or the tools with which they have to work.

They're sure they're right before going ahead, and they know what to do without being told.

Show an interest in the young apprentice and help him whenever you can.

It is inevitable that errors will creep into a complicated machine drawing, so don't be too harsh in criticizing the draftsman—he's human like yourself.

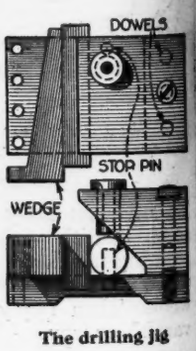
Don't try to grind your personal "axe" in this shop, or in any other.

Gages should be kept clean and handled carefully.

It is becoming more and more the custom to establish "standard time" for work to be performed in the machine shop; standard time is merely the shortest possible time in which a job can be done.

Quick Acting Jig for Drilling Uses a Wedge as a Clamp

FOR drilling cross holes in round stock, the jig illustrated, which employs a wedge for clamping, allows rapid work. The blank is inserted and the wedge tightened by a hammer blow. Striking the other end of the wedge releases the piece. —F. C.



The drilling jig

See New Financial Department on Page 4—Front Section.

RADIO BOOK FREE

Tells how you can make big money in world's newest and greatest field. Presents lifetime opportunity in Radio. Right now we want live agents and dealers in every locality; up to $100 a week easy.

40% TO 60% PROFIT

Simply send name for this big illustrated book explaining liberal profit proposition and how to get latest radio goods at wholesale. Also prices on parts, sets and accessories and amazing special offers—all free. Write today.

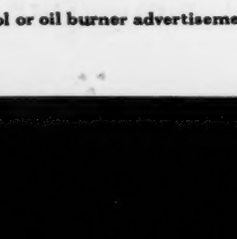
STANDARD RADIO CO.
1404 Walnut St., Kansas City, Mo.

30 Days' Free Trial

Start a Big Profit Making Business of your own—"One day Battery Charging." Requires small space and practically no investment. Anyone can successfully operate. Charges batteries in 1-3 the usual time at 1-2 the cost. Every car owner a customer. Try it for thirty days at our risk, under absolute money back guarantee. The HB One Day Battery Charger will pay for itself on easy monthly payment plan with practically no expense to you—and bring you a handsome profit besides.

$150 to $300 Monthly Profits Reported by HB Users Everywhere

Write for full particulars in Bulletin M. NOW!
HOBART BROS. CO. Box P10 Troy, Ohio



TOOL CHESTS

FOR PARTICULAR MEN

Toolmakers and Machinists will find the right Case in our

FREE CATALOG

Send for it TO-DAY.

H. GERSTNER & SONS
534 Columbia St., Dayton, O.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS.

What do You have to say
when you are with interesting people?

Can you hold up your end in a general conversation—or are you tongue-tied when with people?

AFTER the weather has been discussed and exhausted it is only the well informed man—the good talker—who can hold the attention and interest of his friends.

Everybody envies a good talker. You know from experience the big advantage the man or woman has who is an easy, fluent talker. In every-day life men and women who have this personal advantage are popular—sought after. And in their trade, business or profession they are the ones that get to the top.

The valuable ability of being able to converse smoothly, naturally and with full confidence is based on having at your command a fund of knowledge that will be of interest to those you are talking to.

What Worth-While People Are Talking About

Today the most entertaining, the most fascinating subjects are those that deal with applied science—radio . . . aeronautics . . . the automobile; new discoveries in health . . . evolution . . . electricity.

These are the subjects that intelligent people are thinking and talking about. These are the things the worth-while men and women of your town or city are discussing.

To make it possible for you and the other thousands of men and women who feel the urge to keep up with the important things scientists have definitely established and the new discoveries that they are making we offer you THE POCKET GUIDE TO SCIENCE and 14 issues of POPULAR SCIENCE MONTHLY—all for less than 12 issues of POPULAR SCIENCE MONTHLY would cost you on the newsstand.

THE POCKET GUIDE TO SCIENCE is written in simple question-and-answer form that educators have found to be the most effective way for telling the known facts on a specific subject. In this one brilliant book of 284 pages have been condensed all that you probably will ever want to know about science.

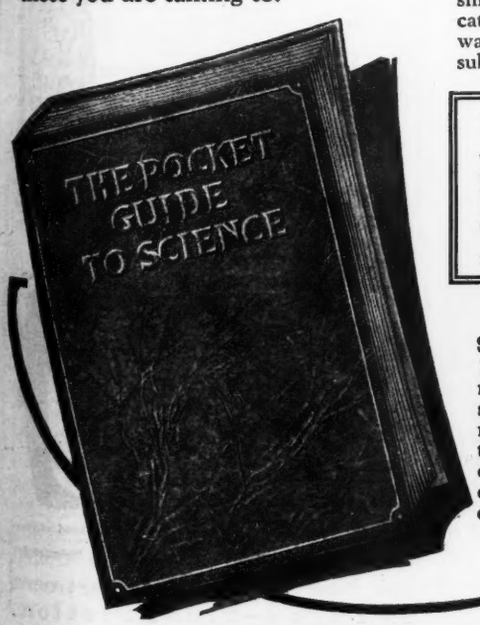
You are assured of the accuracy of the answers in THE POCKET GUIDE TO SCIENCE, as it was edited by Dr. E. E. Free, who has a remarkable genius for condensing the known facts about the world we live in into short, easily remembered paragraphs.

SPECIAL OFFER

THE POCKET GUIDE TO SCIENCE is not for sale. It is included, without any extra charge, with a 14 months' subscription to POPULAR SCIENCE MONTHLY.

POPULAR SCIENCE MONTHLY "carries on" from where THE POCKET GUIDE TO SCIENCE leaves off. THE POCKET GUIDE gives you all that the scientists have discovered up to right now—POPULAR SCIENCE MONTHLY will give you all the important, interesting and new discoveries of science for the next 14 months.

It takes over 300 articles and pictures every month to tell the readers of POPULAR SCIENCE MONTHLY all that has happened in the scientific, radio, mechanical and automotive fields.



Your Name in Gold on this Wonderful Book

THE POCKET GUIDE TO SCIENCE is bound in beautiful flexible fabrikoid. *We will stamp your name in 22-carat gold on the cover of THE POCKET GUIDE at no extra cost to you if you use the coupon below immediately.*

We extend to you the Special Offer of a 14 months' subscription to POPULAR SCIENCE MONTHLY (*regular price by the month would be $3.50*) with THE POCKET GUIDE TO SCIENCE—all for $2.95, plus the few cents' postage.

If you are already a subscriber to POPULAR SCIENCE MONTHLY, we will extend your subscription 14 months if you accept this offer.

SEND NO MONEY

Send no money, just the coupon. If within 10 days after you receive the book and magazine you decide that you are not satisfied in every particular, you may return them, and your entire payment will be refunded promptly and without question. Could any offer be fairer?

Popular Science Monthly
250 Fourth Avenue, New York

I accept your offer of THE POCKET GUIDE TO SCIENCE and a 14 months' subscription to POPULAR SCIENCE MONTHLY. I will pay the postman $2.95, plus the few cents' postage when he delivers the POCKET GUIDE and the first issue of POPULAR SCIENCE MONTHLY. If the book and magazine are not fully satisfactory to me, I will return them within 10 days and you are to promptly refund my full payment. Please stamp my name in gold on the POCKET GUIDE TO SCIENCE.

Name .....

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10-26

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

WINTER
Comfort

Less furnace drudgery—
warm rooms—no draughts—
smaller coal bills—
heat evenly distributed—

CROWN FUEL SAVER
mixes RED HOT OXYGEN WITH GASES OVER FURNACE FIRE BED
SAVES 20% *of* FUEL

The saving of 20% of fuel is but one of the advantages of the Crown Fuel Saver. Users praise it for many other reasons.

One user likes the Crown because it keeps his wife from shoveling coal during his absence. This man tends the fire in the morning, and it does not have to be touched again until evening. Another use finds he can burn lower grade coal, get as much heat—and make a double money-saving.

Still other users find that the Crown does away with smoke, coal gas, and clinkers—lessens the amount of ashes—and sends a glowing warmth thru every room in their houses.

It will pay you to learn about the Crown

—indeed it will pay you to order one now, and place it on your furnace door ready to give you its benefits when the cold weather sets in. You can't lose—for we absolutely *guarantee* that the Crown must save at least 20% of the coal you ordinarily use—or we will refund its purchase price.

Proved by 11 years' use

The Crown fits the feed door of any furnace or boiler—home or industrial—requires no regulation as it works automatically.

Write today

If you want real comfort this winter, smaller coal bills, and less furnace worries, write for full details and special low price of Crown with money-back guarantee.

CROWN FUEL SAVER CO.
110 N. 10th St. Richmond, Indiana

Distributors wanted—Men who seek a solid business connection and a steady income, write today. Wonderful opportunity as there is a Crown Fuel Saver or a Smoke Preventor to meet the needs of any heat producing plant from the parlor Arcola to the largest power plant.

Better Shop Methods

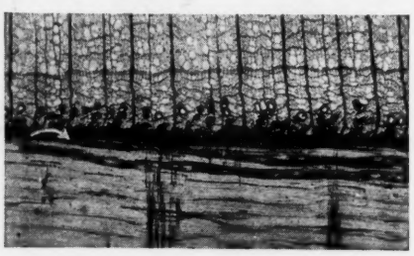
Making Glue Stick

(*Continued from page 70*)

had two or three different foremen, as the superintendent thought that the man in charge was at fault. The wheels sometimes would give out in a half hour, as the work was hard on them. All kinds of stunts were tried to overcome the difficulty; many different kinds of wheels and glue were bought, but without results."

"There is more to this glue problem than most of us think," chimed in Bill Hart. "I'd like to know a little more about it myself, as I'm working on a small pattern at home and must admit that I don't know much about glue."

"Well, so far as gluing at home goes," Peters remarked, "I don't believe you can do better than use the best obtainable grade of liquid glue. I'll tell you why. You don't have to bother about soaking it, heating it, keeping the gluepot clean, and making it up fresh every time you want to use a little glue. The liquid glue is always ready and if it is used properly,



Glue uniting two wood surfaces enters the open cell cavities and clinches the joint by millions of tiny barbs and anchors, as indicated in one place by the arrow. This is an enlarged section through a glued joint of plywood—two pieces of wood with the grain of one running at right angles to the grain of the other. This photograph has been furnished by the U. S. Forest Service

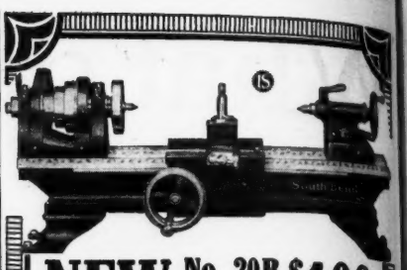
and especially if a thin sizing coat of the glue is applied to the parts a little beforehand, it makes a joint that is as strong as the best hot glue. Then, too, you have more time to get the joint just right with liquid glue; with hot glue you have to work like lightning or it becomes chilled.

"To get back to this foreman I was telling you about—he certainly knew where to look for the trouble with those polishing wheels, and it didn't take him long to straighten them out. The superintendent of the shop was hard to convince at first and the new man—his name was Jim Williams—had difficulty in getting him to change his methods. Williams threatened to quit unless he was given a chance to prove his claims, and finally the big boss gave in and let him show what he could do. From all accounts I have heard, they will never change back to the old methods."

"What was the trouble?" asked Hart.

"Why, the whole secret was in the glue and the way it was handled. Williams fixed up a room in one corner of the shop with partitions and had it ventilated so that no drafts could come through the room while working with the glue.

"The shop (*Continued on page 127*)



NEW No. 20B LATHE $100

9 in. x 2½ ft.; 11½ in. between centers

No. 20-B is our regular Quick Change Gear Lathe stripped of all extras that are not needed in the small shop. Can be furnished with 3, 3½ or 4 foot Bed—also Compound Rest and Long Legs at slightly extra prices.

Can Do All This Work

—Turn Commutators, undercut Mica, turn Pistons, can be fitted with 6-in. Chuck, will bore, drill, etc., can also be fitted with our draw-in chuck attachment, capacity of Collets 0 to ½ inch. Write for Folder No. 20-S.

—Easy Payments if Desired—

SOUTH BEND LATHE WORKS
1827 E. Madison St., South Bend, Ind.

The Old Reliable Credit Jewelers **LOFTIS BROS. & CO.** Est. 1858 Largest in the World

DIAMONDS WATCHES

Genuine Diamonds Guaranteed

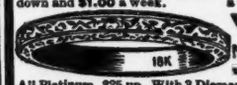
CASH OR CREDIT

Our reputation is your safeguard **Get YOUR Diamond Now!** Satisfaction guaranteed or money back

We import Diamonds direct from Europe and sell direct to you by mail—this is why we can deliver to you so much more value for your money. Every gem selected by experts for superior quality, color and brilliancy. Order your ring now from our big assortment of designs. **CREDIT TERMS**—Pay 10% down and balance in weekly, semi-monthly, or monthly payments. All goods delivered on first payment. **DIAMOND BOOK FREE!**—Our big new Catalog shows over 2000 amazing bargains. Write today for your FREE copy.

Wrist Watch—14-K white gold, hand engraved case. Fancy wing ends. Silver dial. High grade 15-Jewel movement, $25. $2.50 down and $1.00 a week.

17-Jewel Elgin—No. 15—Green gold, Elgin watch; 25-year quality case; 12 size; gilt dial; $30. $3 down and $1.00 a week.

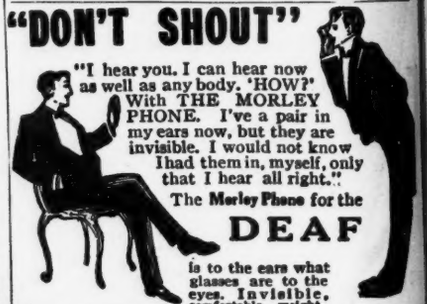


Wedding Rings No. 824—The "Elite" 18-K white gold $7.50.

All Platinum, $25 up. With 3 Diamonds, $50; 5 Diamonds, $70; 7 Diamonds, $80; 9 Diamonds, $100; surrounded by Diamonds, $200.

LOFTIS BROS. & CO. *Established 1858—Stores in Leading Cities*
Dept. E-871 108 N. State St., Chicago

"DON'T SHOUT"



"I hear you. I can hear now as well as any body. 'HOW?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The **Morley Phone** for the

DEAF

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 10 S. 18th Street, Philadelphia

See New Financial Department on Page 4—Front Section.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Better Shop Methods

Making Glue Stick

(*Continued from page 126*)

owner had been buying the wrong kind of glue for a number of years and had not known it. It was found that glues were made for many different purposes and that an especially high grade glue was necessary for polishing wheels. Ordinary glues and glues for other purposes would not work at all. On account of the high speed and hard, rough work that a polishing wheel does, the strain upon the glue holding the abrasive is terrific. For this reason the best quality and strongest glue obtainable is required to resist successfully the tearing of the work on the wheels.

"The boss put up a howl when he found that the glue cost far more than he had been paying, and he was mad enough to almost fire Williams. But in less than a week after that he saw the results, and since then he figures that he has saved many thousands of dollars.

"This glue was what is called first run hide glue, as it alone has the maximum strength, which is most important for that kind of work. Glue for polishing wheels should be flexible and tough because they flex and the glue must bend with them.

"This foreman told me that glue in the ground form is best for polishing wheels, as it is much easier to handle than flake or sheet glue, although sheet or flake glue can be used. A simple test for the quality of glue for polishing, he told me, is to bend a sheet of it double. If it bends without breaking, it is a fair indication of its strength and quality. But you can't use that test with ground glue; you have to trust the manufacturer.

"It is also important to store the dry glue in a cool, dry place. This prevents rapid deterioration and keeps it sweet for a long time. (*Continued on page 128*)

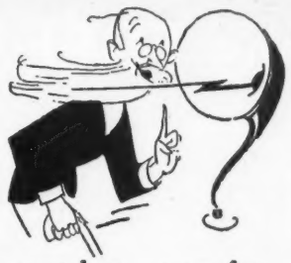
Preparing Hot Glue

Soaking—Use distilled water, if possible. Soak cake glue 12 hours, flake glue, 8 hours, ground glue, 3 hours. Measure quantities exactly by weight, using either tested containers, one holding a pound of water and the other a pound of glue, or a weighing scale. The proper proportions should be ascertained directly from the manufacturer of the glue.

Melting—Use water-jacketed heater and stir. Temperature must not exceed 140 deg. F. Test with thermometer. After four hours at this heat the glue is much weakened; therefore, plan to use up each batch of glue in less than this time. Brushes and pots should be scalded at night as any residue of glue left overnight is apt to spoil fresh glue made in the morning, reducing its value by as much as one half.

Using—Apply hot glue quickly in warm room free from drafts, yet well ventilated. Heat work, when possible, to about 120 deg., but do not use too much heat to hasten the hardening. Only glue that has set slowly and naturally gives maximum strength in a joint. This requires 48 hours.

These suggestions are abstracted from instructions on the use of glue by Bradford H. Divine, A.S.M.E., Ex-President of the Metal Finishers' Equipment Association.



There's sound sense in quiet charging—

Clear, full, volume in your reception is the only way in which your Rectigon "makes itself heard." All because of the wealth of pep it packs into your batteries. But you'll never hear a peep from a Rectigon, itself, while it's doing its charging job. Not a murmur—not a bit of fuss. It's so quiet it wouldn't disturb the snooze of the lightest sleeper. Rectigons are popular for home charging because they do away with even the slightest annoyance and bother.

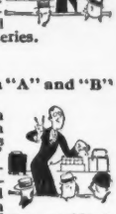
when you keep batteries lively with

No Acids, no Chemicals—no moving parts—nothing to spill or burn. No muss, no worry. You'll have no spoiled rugs, no ruined clothing.

Saves Its Cost in Short Order—Count the dollars spent in a few trips to the service station and you'll hotfoot it for a Rectigon, for the good it does your pocketbook as well as your batteries.

Snaps On in an Instant—Just plug into the light socket, snap on the terminals. Saves service station bother. Spares interruptions caused by absent batteries.

Charges Both "A" and "B" Batteries—Keeps both packed with power. Bulb is used for "B" battery charging and it is enclosed, like all other parts, in metal, safe from accident. (Rectigon charges automobile batteries, too.)



Perfect Safety for Your Set—If you tune in while you're charging there'll be no harm either to set or batteries. Nor will batteries be discharged if anything happens to the current while your Rectigon's attached.

The **Westinghouse Rectigon Battery Charger** ©, 1926 W.E.&M.Co

THE RECTIGON'S a superb Westinghouse product. Things you *can't* see, like extra heavy insulation, things you *can* see, like the durably enameled case—all are of highest quality. Westinghouse also manufactures a complete line of radio instruments, and Micarta panels and tubes.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
Tune in on KDKA - KYW - WBZ - KFKX

No Storage Battery Radio is Complete Without a Rectigon

Absolutely Guaranteed

WADE BENCH LATHE

For Repair Shops, Amateur Mechanics, Model Makers, Inventors who want a real, *accurate* machine tool at a price within easy reach. *A complete shop in itself.* Capacity 4 in. diameter x 12 in. length. Handles metal, wood, and other materials. Turning -- facing -- boring -- drilling--winding--thread cutting. The "Wade" is a bargain at several times the price. Guaranteed a high degree of accuracy, quality of materials, workmanship and finish.

The sliderest has travel entire length of bed. Leadscrew inside bed. Hollow spindle.

No. 1 Lathe, plain headstock - - $28.00
No. 2 Lathe, back-geared - - - 38.00

Either lathe with 18 in. length between centers, $7.00 extra. Complete line of accessories. By all means write for this free book.

THE GEROLD COMPANY
Dept. PS-14, 120 Liberty St., New York

WADE

S. O. S. HYDROMETER

Simple—durable—accurate—no float to break—balls easy to read.

Swim all three, charged fully
Sinks the *white*, charge still *right*
Sinks the *green*, charge is *lean*
Sinks the *red*, charge is *dead.*

Over four million patented Chaslyn Balls used by leading battery manufacturers as standard equipment in glass-cased batteries and power units. Ask your dealer—if he can't supply, send seventy-five cents to

THE CHASLYN COMPANY
4613 Ravenswood Ave. Chicago

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

Send for Book of 200 Home Plans FREE!

Home No. 616
5 Rooms. All Materials
$1511

You Can Build this Plan-Cut Home Yourself

Get our low *wholesale prices* before you build. Many say they save as high as $2,000. We furnish complete plans and *highest quality* material. 200 distinctive designs. Many built-in conveniences to save steps and lighten housework. 200,000 customers make our values possible.

Build Ready-Cut We saw, cut and fit all parts possible by machinery. Saves you 30 per cent labor. Many do own building. Permanent construction.

5,000 Building Bargains Everything for building, remodeling or repairing, at wholesale prices. Send for catalog.

Mail Coupon *"Book of 200 Homes"* shows photos, floor plans, prices of Bungalows, Colonial—modern, distinctive 4 to 9 room homes.

144 Pages—Plans Photos Etc.

Gordon-Van Tine Co.
ESTABLISHED 1865
Satisfaction Guaranteed or Money Back
829 Case Street Davenport, Iowa

Gordon-Van Tine Co.
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☐ Build a.....
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Send me proper catalog.
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A Good Bookcase for the price of a good book!

$3.00 Per Section without Doors
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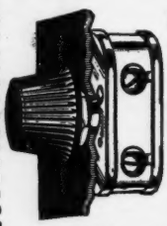
On Approval—Direct to User

Lundstrom
IT GROWS WITH YOUR LIBRARY
SECTIONAL BOOKCASE

Made for and universally used in the finest homes and offices throughout the country. Made in sections of different sizes, combining utility, economy and attractive appearance. Price complete as shown above, with top, base and three book sections with **non-binding, disappearing, felt-cushioned** glass doors, beautifully finished in plain golden oak, $15.75; without doors, $13.50. In quartered oak, or in imitation mahogany (willow), with doors, $18.25. In genuine mahogany, with doors, $23.50. Other styles at correspondingly low prices. **Shipped direct from factory** ON APPROVAL at a considerable saving TO YOU. Write for new catalog No. 31.

The C. J. Lundstrom Mfg. Co., Little Falls, N. Y.
Manufacturers of Sectional Bookcases since 1899

Bradleystat
PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

Allen-Bradley Co.
Electric Controlling Apparatus
293 Greenfield Avenue Milwaukee, Wis.

Simplifies!

Full, clear, rich tone depends upon careful, compact wiring. AMPERITE eliminates complicated wiring, avoiding leaks and losses. 4 Amperites No. 1A and 1 Amperite No. 112 used in the five tube receiver described in this issue.

Radiall Company
Dept. P. S.-2, 50 Franklin Street, New York City

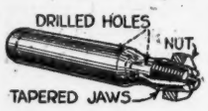
Write for FREE Hook-ups

AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" Rheostat

Better Shop Methods

Small Spring Chuck for Lathe or Drill Press

SMALL shops can use the simple type of chuck illustrated to advantage. The shank can be made straight as shown and held in a larger chuck, or it could be tapered for use in a drill press or on a lathe. It is made of machine steel, casehardened. The nut is a semifinished nut retapped with pipe thread. The hole is made to fit the drill to be used, and the neck turned to increase the springiness of the jaws. The larger hole is drilled from the rear, and two hacksaw cuts are made to form jaws.



Simple, cheaply made type of draw-in chuck

Semicircular Sharpener for Pointing Drawing Pencils

THIS simple pencil pointer for draftsmen consists of a semicircular wooden block about 2 in. in diameter. The curved surface is covered with a piece of emery cloth of any fineness desired. It is better to glue the cloth on rather than use tacks. This form of sharpener seems to produce a better point than flat surface blocks.

A pencil pointing block for the busy draftsman

Making Glue Stick

(*Continued from page 127*)

A bad odor from glue is a sure sign that it is rotting and losing its strength.

"After the first month on the job, Williams was told by the boss that he could run things to suit himself and order anything he wanted.

"'All right,' said Williams, 'I'll take you at your word; put me down for a new set of aluminum glue kettles. This outfit you have here is all worn out anyway and it's not easy to get the best results yet with it. Aluminum is greasy by nature and glue does not stick to it as it does to iron or copper. It is also easier to clean. I want to make a rule to keep everything clean about this place. A little later on I may want other things, but just now the main idea is to be sure that every bit of glue we buy is of a uniform quality and that we always handle it properly.'"

DRAFTSMEN will find that many common calculations can be simplified if they will note down and use the numerical values represented by the sides of their 30-60 deg. triangle. If the hypotenuse is regarded as 1, the longer leg is .8660 and the shorter leg .5; if the longer leg is regarded as 1, the hypotenuse is 1.1547 and the shorter leg .57735; if the shorter leg is 1, the hypotenuse is 2 and the longer leg 1.73206.

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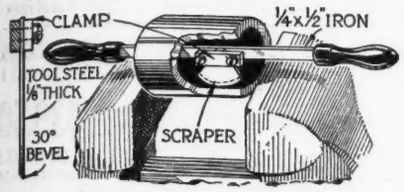
Better Shop Methods

Double-Handled Tool for Scraping Bushings

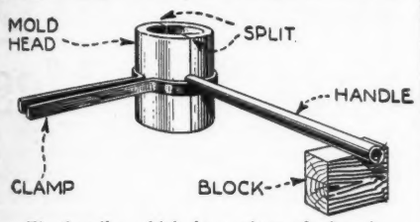


SCRAPING bushings with a single-end scraper is such a tedious job that one machinist made the double-handled tool shown. It has a tool steel blade that can be changed quickly for a sharp one. A small clamp holds the blade firmly in place.—W. L. M.

Casting a Soft Hammer

FOR assembling machinery and tools, the old-time soft hammer seems almost a necessity. In order to have a supply on hand, and at a low cost, we made up several sizes of molds for casting them ourselves.

The handles are short lengths of ¼, ½, or ¾ in. pipe with the end split and bent

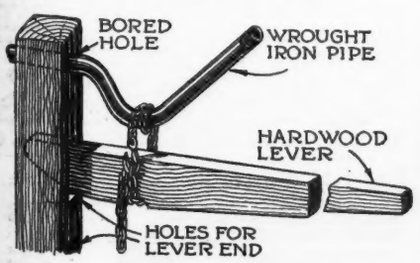


The handle, which is a piece of pipe, is inserted in the mold before the lead is poured

out to stay securely in the soft metal. The molds for the heads are pieces of pipe, 1, 1½ or 2 in., depending on the weight desired; these are split and provided with a hole for the insertion of the handle. For each mold a clamp is made of light bar iron.

Most of the hammers are cast of commercial lead, which is the softest and also the cheapest. For harder hammers, babbitt metal may be used.—W. C. C.

How to Bend Small Pipes without Special Tools



JUST because he was away from the shop and had few tools did not prevent one mechanic from bending some small pipe accurately and easily. He bored holes in a convenient post to receive the pipe and the end of a wooden lever, as shown. A short length of chain completed the equipment.—G. A. LUERS.

The New Triple Duty GOLD SEAL HOMCHARGER

The World's Most Popular Battery Charger

$19.50 Complete

Charges three times faster!
Rejuvenates lifeless tubes—
supplies current for 8-volt power tubes!

It's more than just a battery charger—the new Triple Duty Gold Seal Homcharger. Charges three times as fast as other chargers—fully charges the average battery overnight. No bulbs—no liquids—Homcharger can be used for charging automobile batteries, too!

An exclusive Homcharger feature this season is the new tube rejuvenation process. Terminals are provided for bringing old radio tubes back to life without removing them from the set.

Homcharger may also be used as a power unit for 8-volt A. C. power tubes. Provides uniform light socket current for operating these tubes.

Only Homcharger offers these exclusive features—still Homcharger costs no more than ordinary battery chargers. Any radio dealer can show you the new Triple Duty Gold Seal Homcharger.

"Behind the Scenes in a Broadcasting Station" an interesting 24-page booklet, will be mailed free on request, together with literature describing the Triple Duty Gold Seal Homcharger.

The Kodel Radio Corporation, 500 E. Pearl St., Cincinnati, O.
Owners and Operators of Broadcasting Station WKRC

Battery Chargers Power Units KODEL Radio Receivers Loud Speakers
POWER SPECIALISTS SINCE 1912

Your Musical Bump will pay You well

START now to develop your talent with a Conn easy-to-play band or orchestra instrument. Demand for players exceeds supply. Free Trial; Easy Payments on any Conn. Send for free literature and details; mention instrument.
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Do Wonderful Chemical Tricks and Experiments with CHEMCRAFT Junior!

Make your own ink, dye cloth, test water and soil, and learn about Chemistry. Surprise and puzzle your friends with Magic Chemical Tricks; write secret letters with invisible ink; pour blue, brown, and black liquid from a glass of water; make a magic pitcher of bluing; make your own magic writing paper. It's all easy if you have CHEMCRAFT JUNIOR. Order right away and get a FREE copy of the Chemcraft Chemist magazine; full of interesting chemical information, experiments, pictures and news from club members. You'll like it. Be sure to send today.

Only 50c Postpaid
The Porter Chemical Co., 115 Summit Ave., Hagerstown, Md.

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"They've tripled your salary, dear"

"I TELL you, Tom, it was a lucky day for both of us when you sent in that I. C. S. coupon. You'd never be where you are to-day if you hadn't decided to study in spare time just when you did."

Spare-time study with the I. C. S. is winning promotions for thousands of men and bringing happiness to thousands of homes all over the world. In offices, shops, stores, mines, mills and on railroads, I. C. S. trained men are stepping up to big jobs, over the heads of older men, past those whose only qualification is long service. There is a job ahead of YOU. Some man is going to be picked for it. The boss can't take chances. He is going to choose a trained man with sound, practical knowledge of the work.

Get busy right now and put yourself in line for that promotion. You can do it in spare time in your own home through the International Correspondence Schools, just as thousands of other men and women have done.

The first step they took was to mark and mail this coupon. Make *your* start the same way—and make it right now.

Mail the coupon today for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7607-E Scranton, Penna.

Oldest and largest correspondence schools in the world

Without cost, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

BUSINESS TRAINING COURSES

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☐ Accountancy (including C.P.A.)	☐ Civil Service
☐ Nicholson Cost Accounting	☐ Railway Mail Clerk
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☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
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☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
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Street Address.....

City.....State.....

Occupation.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian Limited, Montreal

1927 CATALOG JUST OUT!

SEND FOR YOUR COPY

RANDOLPH RADIO CORP.

180 N. UNION AV. Dept. 3 CHICAGO, ILL.

Read Interesting article on Page 4. "How $100 a Month, Invested Properly, Can Make You Independent."

Better Shop Methods

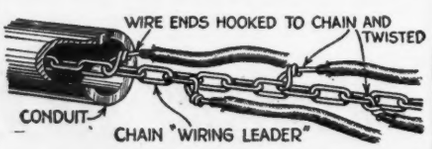
Movable Lamp Stand for Lighting Lathe Work

The light can be adjusted to suit turning or boring jobs

CONSTRUCTED of scrap pipe and parts, the lamp stand illustrated will be a useful addition to the "lathe tools." The base should be heavy to prevent overturning; an old piston will make a good one. The flexible metal conduit and the shade are about all that will have to be bought. The stand can be placed behind the lathe or moved away when not in use. A blue lamp of about fifty or sixty watts seems best.—H. L. W.

Chain Aids in Pulling Wires Through Small Conduits

ONE electrician found that a chain was better than the regular fishing tape for pulling a number of electric wires into a small conduit. The wires are hooked to different links of the chain,



The wires are hooked to different links, so they can be pulled through with less effort

the effect being to taper off the usual "head" where the wires connect to the tape. This allows the group to be drawn more easily around bends. The chain is pulled with the usual tape.—G.A.L.

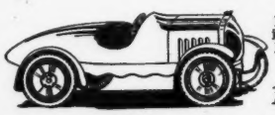
AT THE suggestion of a heating contractor, the U. S. Bureau of Standards recently tested pipe joints made with lead filings from a coarse rasp in comparison with the red lead and white lead pastes ordinarily used. Joints made with the lead filings uniformly withstood a pressure of 8,500 lbs. without leaking, yet could be unscrewed easily. Similar joints were made with lead paste and only half of them remained leak proof at that pressure.

SQUAB BOOK FREE

Make money breeding squabs, sold by millions; write at once for free 40-page book, beautifully printed in colors, telling how to do it. Read how marketmen Conron, Schweitzer, Silz, of N. Y., want thousands squabs daily, demand enormous. It pays to raise this luxury product. Ready for market in four weeks. We ship breeders everywhere on **three months' trial.** Read how one started small in backyard with no money, now has $30,000 plant, ships 150 bbls. squabs yearly, paid $75-$100 bbl. You can do the same. Many other successful money-making by men, women, everywhere. Write today. **You will be surprised.**

PLYMOUTH ROCK SQUAB CO.
616 H St., Melrose Highlands, Mass. Established 26 years

SPORT BODIES for FORDS at FACTORY PRICES!



This Model in Grey Prime **$39.50**

Write for Booklet A-10 Showing Other Models.

SPORT FACTORIES, Aurora, Illinois

Be Sunburn-Proof!

NOBURN absolutely *prevents* Sunburn. Harmless. $1 per bottle. Money refunded if not fully satisfied. Strong, Cobb & Co., 348 Central Av., Cleveland, O

NoburN

Delivered to you Free

for 30 days trial on approval. Your choice of **44 Styles,** colors and sizes of the famous **Ranger** Bicycles. Express prepaid. Bicycles **$21.80** and up.

$5 a Month If desired. Many boys and girls easily make the bicycle earn the small monthly payments.

Tires wheels, lamps and equipment at half usual prices. Write for remarkable factory prices and marvelous offers.

Mead CYCLE COMPANY DEPT. G250 CHICAGO

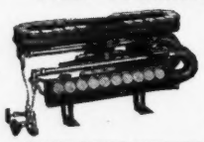
Write us today for free catalog

Skin Troubles

Cleared Up—often in 24 hours. To prove you can be rid of pimples, blackheads, acne eruptions on the face or body, barbers' itch, eczema, enlarged pores, oily or shiny skin, simply send me your name and address today—no cost—no obligation. **CLEAR-TONE** tried and tested in over 100,000 cases—used like toilet water—is simply magical in prompt results. You can repay the favor by telling your friends; if not, the loss is mine. WRITE TODAY.

E. S. GIVENS, 458 Chemical Bldg., Kansas City, Mo.

This Wonderful Invention



converts any ordinary cook stove into a gas range. OXO-GAS is made from kerosene and air. Cheaper, cleaner and more efficient than coal. Types for all heating purposes. Responsible distributors wanted.

GLORIA LIGHT COMPANY, 127 N. May St., Chicago, Ill.

ZIP-ZIP

Here is a letter we received from a lady from way out west.

Gentlemen:

My boys were so delighted with the Zip-Zip shooters that they ordered from you that I am enclosing check for one dozen more, I want each of their friends to have one also. Please send these as soon as possible.

Thousands of boys are made happy with this wonderful Zip-Zip shooter. Order from us or your dealer. 35c each or 3 for $1.00. Send stamps, coin or money order.

AUTOMATIC RUBBER CO., Dept. 22, COLUMBIA, S. C.

BLANK CARTRIDGE PISTOL

Protection Against Burglars, Tramps and Dogs

PRICES 50c. $1.00 POST-PAID

Well made and effective; modeled on latest type of Revolver; appearance alone is enough to scare a burglar. When loaded it may be as effective as a real revolver without danger to life. It takes standard .22 Cal. Blank Cartridges obtainable everywhere. **Price 50c. Superior quality $1.00 Postpaid. Blank Cartridges,** by express, **50c** per **100.**

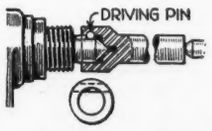
Johnson Smith & Co. Dept. 583, Racine, Wis.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

Special Driving Arbor for Light Lathe Work

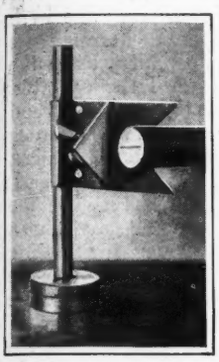
FOR light lathe operations where the cut is not heavy enough to loosen the live center in the spindle, the arbor shown will sometimes serve conveniently. It permits machining on either side of the work without interference from a driving plate. Furthermore, in filing or polishing there is no danger of being caught by a set screw.—FRANK N. COAKLEY.



No dog is needed with this handy arbor

Self-Setting Gage for Marking Centers of Shafting

SHAFTING held in vee blocks on the layout plate can be centered in no time with the tool illustrated. It consists of a round base into which is fixed a rod. Sliding on the rod is a vee having a marking point at right angles. In use, the vee is adjusted to fit the shaft and the sliding portion clamped with the thumb screw. Then the tool is turned so that the marking point can scribe a center line.—H. MOORE.



Setting the gage to the correct height by means of the vee

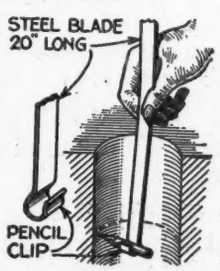
A Safe Lifting Bar for Use in Shop or Shipping Room

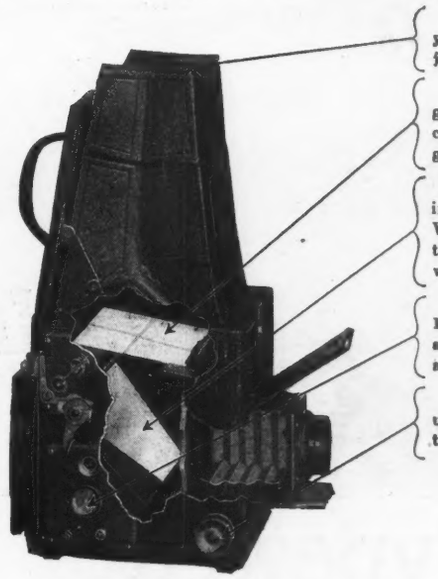
IT IS possible both to simplify and make more safe the moving of heavy parts around the shop or shipping room through the use of a lifting bar of hardwood with an iron shoe fitted on the end. This takes the place of a crow bar and loose blocking, which are apt to slip.

A heavy lifting bar of this type often serves better than ordinary crowbars and blocking

Handy Pencil Holder for Inaccessible Places

A LIGHT piece of band-saw steel formed with a hook on the end makes a good holder for a pencil or crayon when marking in inaccessible places.—GEORGE W. ROYER.





Look into the focusing hood and you see a reflected image of the subject, right side up, full picture size.

When the image on the ground glass is sharp, the focus is sharp; if composition is correct on the ground glass it will be correct in the picture.

This tilted mirror reflects the image to the ground glass above. When the exposure lever is pressed the mirror swings upwards out of the way, releasing the shutter curtain.

Focal plane shutter has speeds of 1/5 to 1/1000 of a second and passes about one-third more light than does any other type of shutter.

Focus is under easy control here until the instant at which the left thumb trips the exposure lever.

Examine a Graflex

and you will see why Graflex pictures are so sharp and clear. The reflecting mirror makes exact focus sure. The shutter's range and the lens's speed let the exposure record the subject in detail.

f.2.5 A new model—3¼ x 4¼ Revolving Back Graflex, Series C—is equipped with Cooke Anastigmat *f*.2.5, over three times as fast as the fastest lens ever before offered on a Graflex. This camera can make sensational instantaneous pictures in rain or under shade or indoors. Price $260. Other models, $58.50 up. Visit a dealer or write to Rochester.

Graflex cameras are now made by
THE FOLMER GRAFLEX CORPORATION
ROCHESTER, N. Y.

For sale by
EASTMAN KODAK COMPANY
ROCHESTER, N. Y.

BURN YOUR NAME ON TOOLS
WITH THE
ARKOGRAF
Protect Your Tools From Theft. Write with electricity any name or design on the hardest and finest tools and instruments, or any metal, like writing on paper with pen or pencil. Complete Outfit $3.50 Prepaid Anywhere. Interesting illustrated circular free. Write today. Agents wanted.
ARKOGRAF PEN CO.
1171-A East Stark St., Portland, Oregon

CARTER
"Short" Jack

RMA Open circuit 25c ea. Closed circuit 30c ea.
Fits any plug. Wide terminals. Easy soldering. Heavy insulation. Strong springs.
"Tip" Jack

10c ea. (S)
Minimum size. Sturdy. Nickel plated. Heavy contact spring. Carter quality.
In Canada: Carter Radio Co., Limited, Toronto
Carter Radio Co.
300 S. PAGINE AVENUE
CHICAGO, ILL. U.S.A.

SEND NO MONEY
Genuine Full Cut Diamonds
Terms If Desired—6 Months to Pay. Outside U. S. Cash with Order
$25

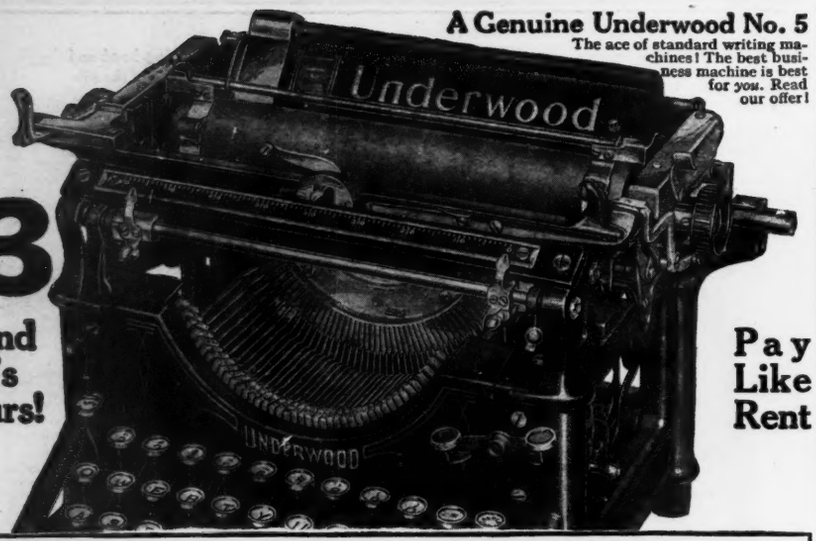
New No. 6132
This Reg. Trade Mark guarantees you genuine diamonds.
No. 6132—Solid Gold Men's Initial or Emblem Ring. 2 Genuine Diamonds 4-100 each. 14-Kt. White Gold Top. Gold Emblem (any Lodge) or any initial (Old English) yellow or white Gold, inlaid in Genuine HOPE RUBY Also, in Black Onyx $25
No. 6598. Any initial (raised gold) or Eastern Star, Rebecca, Mason, Shrine, K. of C. emblem instead of initial if desired. Send number of ring, size of finger, initial or emblem desired and ring will be sent for inspection.
Ask for Free Catalog
Buffalo Jewelry Mfg. Co.
"The Mail-Order House"
Dept. A
501 Washington St., Buffalo, N. Y.

No. 6598
No. 6598—Ladies' Ring Genuine Black Onyx with Genuine Full Cut Diamond. 14-Kt. White Gold. $15

(S) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

A Genuine Underwood No. 5

The ace of standard writing machines! The best business machine is best for you. Read our offer!



$3

—and It's Yours!

Pay Like Rent

Own a Typewriter!

A Bargain You Can't Ignore! Every Member of the Family Will Use and Enjoy It! Try it Free and See!

GET YOUR typewriter *now*. A genuine, Shipman-Ward rebuilt Underwood—"the machine you will eventually buy." Don't send a cent, but do get our special offer—valuable book on typewriting—*free*. You can learn to write on this standard-keyboard Underwood in a day. In a week, you'll feel lost without it! The free trial will *prove* it. Our rebuilt plan gives you the *best* machine and a *big* saving.

Act NOW If Ever!

Speak up, if you want one! Underwood No. 5 is so popular this lot we're completing now won't be long in selling! Rebuilt from top to bottom—*every single worn part replaced*. New typewriters are guaranteed for a year; we guarantee this one *five* years! That's our Better-Than-New Guarantee. And we guarantee a big saving!

We don't want a penny now. Nor any money at all, unless this proves the typewriter bargain of your life. The trial is *free*. If you buy, our easy terms make it a pleasure to pay. There's no excuse now, for not owning a typewriter—and the finest make! We include all tools, cover, etc., all complete, all ready to write. Write us now. Deal direct; we are the largest factory of the kind; we offer the right machine at the right price; we sell the largest business houses.

Typist's Manual

FREE

Get our catalog free; quotes lowest prices and most liberal terms in existence. We'll send a manual free, too; it contains valuable instruction for learning rapid typing, useful pointers for all who use a typewriter, examples of business forms, social correspondence, work for others, etc. Clip coupon *now!*

©1925

Mail This NOW For Free BOOK

SHIPMAN-WARD MFG. CO.
2147 Shipman Bldg., *Chicago*

Please send FREE, full offer, catalog, typing manual, and outline your free course in Touch Typewriting, without obligation!

Name .....

Street or R. F. D. .....

P. O. ..... *State* .....

Silent "B" Power with World Radio Storage "E" Battery

12 Cells 24 Volts

Lasts Indefinitely—Pays for Itself

Dependable. Quiet "B" power, clear without "hum." Economy you have never before thought possible. Convenience. Outstanding performance. Recharged for almost nothing. Solid rubber case insures against leakage or acid. Extra heavy glass jars. Heavy rugged plates. Approved and listed as standard by Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other Radio authorities.

Extra Offer: 4 Batteries in series (96 Volts) $10.50

SEND NO MONEY! just state number of batteries wanted and we will ship same day order is received. Pay expressman after examining batteries, & get cent discount for cash with order. Send your order today—NOW!

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 80 Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. $10.50; 120 Amp. $12.50; 140 Amp. $13.85. All equipped with Solid Rubber Case.

World STORAGE BATTERIES

Set your Radio Dials for the new 1000-watt World Storage Battery Station, WSBC, Chicago. Always something interesting.

KDKA - WEAF - WGN - WJS - KHJ - KGO - KFAF - WJY - KOA

KESTER
READY TO USE
METAL MENDER
The Household Solder

Here's why thousands use Kester Metal Mender.
Simple—"Requires Only Heat" Anyone can use it.
Safe—No messy pots or dangerous acids.
Sure—Genuine Solder makes firm metal joints.
Satisfactory—Works equally well on light or heavy, old or new work.
Economical—Saves many times its price.
Your Dealer Can Supply You

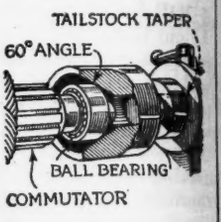
FREE SAMPLE Upon Request

CHICAGO SOLDER COMPANY
4201-323 Wrightwood Ave., Chicago, U.S.A.

Better Shop Methods

Special Tail Center for Holding Armatures

COMMUTATORS on automobile generator armatures may be trued up, whether the center is battered or not, if an internal center similar to the one illustrated is available. This method has the advantage that the commutator is turned on its own bearing.

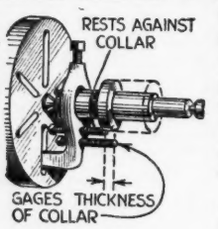


The commutator turns on its own bearing

The cone should be of a size to suit the range of ball bearings coming to the shop, and the taper, to fit the lathe upon which it is to be used.—HARRY W. PETERSON.

Gaging Shoulder Lengths

EVEN the simplest of machine work may be made easier through the exercise of a little ingenuity, as in the example illustrated. A lathe operator, with a number of pins to turn, drilled and tapped his lathe dog so that, when the dog was set with one of the screws against the finished back of the collar, the other gave him a gage for setting the tool to face the collar to accurate thickness.



Two screws are used as gages for the cut

The ends of the screws used in making a gage of this type preferably should be hardened, and they should have flat points.—N. C. F.

How to Remove a Worn Brass Pump Liner Quickly

TO REMOVE a worn brass liner from a pump cylinder is a job that requires no kid glove methods. Break into the liner near the front end at the bottom of the cylinder with a chisel, and raise the metal up from the cylinder wall by prying. Then follow up the cut already started with a bar or round iron rod, flattened at one end like a chisel or wedge and long enough to reach through the cylinder. Insert the bar under the liner and drive it through with a heavy hammer. Ordinarily, the operation can be performed in ten minutes or less.

Before putting in the new liner, it should be checked for length with the old one. If it should be a bit longer, the surplus length can be cut off much easier before it is in place. The new liner should be well slushed with lead and oil and then driven home with a block of wood. Should it go in very hard, it may be necessary to draw it part or all the way with a bolt and washers.

A new liner probably will close up a trifle while being driven in. A new plunger, therefore, may have to be turned down a trifle to fit properly.—W. L.

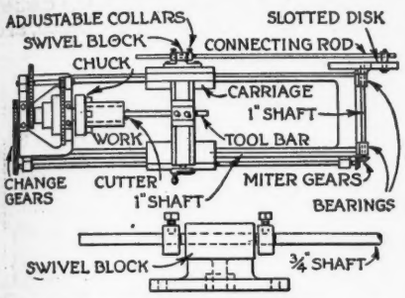
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

Adapting an Old Lathe for Cutting Oil Grooves

SHOPS handicapped by not having a regular oil-grooving machine, can arrange an old lathe to do this work acceptably.

After the apron has been removed from the carriage, a special swivel block is attached to the rear. The lead screw is taken off, and in its place a small shaft is substituted. At the end of this shaft is a miter gear, meshing with a similar gear on a short shaft at the end of the bed. In the case of a very long machine, this shaft could be put through holes made in the bed. On the back end of this shaft there is a slotted disk, similar to a disk used on a shaper or slotter, so that different



How an unused lathe may be fitted to cut figure 8 oil grooves quickly and economically

lengths of stroke can be obtained. A connecting rod runs from the crank pin to the swivel block on the rear of the carriage.

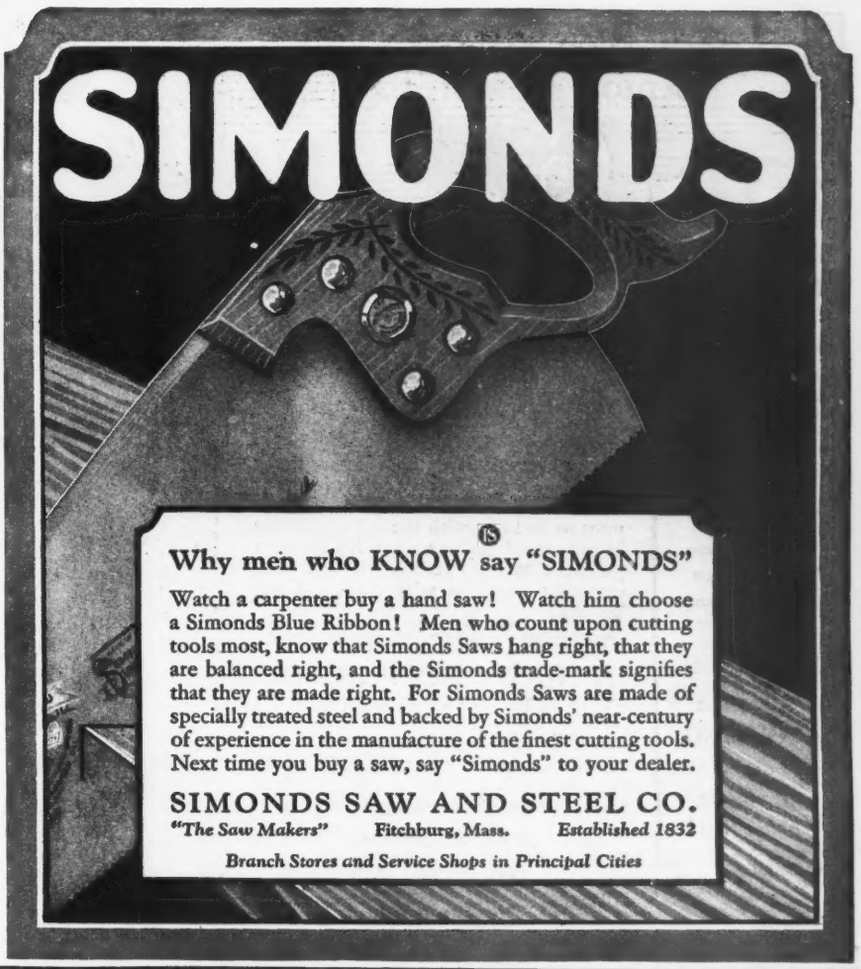
The length of oil groove cut depends on the throw of the crank, which is varied by moving the crank pin out or in. The change gears are provided so that the pitch of the groove may be varied.

For example, if the crank makes one revolution to one of the spindle, the resulting groove will be a loop, not crossing itself at any point. If the spindle is geared to make two revolutions to one of the crank, the groove will cross itself at one point, in the center of the length of the groove. By providing play between the adjustable collars, where they make contact with the swivel block, the tool will dwell at the end of the stroke, thus making an additional variation in the shape of the groove. The contour of the groove is governed by the shape of the tool, which must be ground with plenty of clearance. If desired, a special rigid tool block may replace the compound rest. —H. L. WHEELER.

Bacon Grease Is Valuable As a Cutting Medium

AFTER my wife has fried bacon or ham, she pours the grease into a tin can and saves it for me. When the can is full, I take it to the shop and she starts to fill another. By this means I keep well supplied with the finest kind of cutting medium to use on drills, taps and dies. It is better than oil, for it will flow only as heat is generated and goes right to the point where it is needed.

When tapping, I merely dip the tap in the grease, and that is sufficient for the entire operation.—H. M.



Why men who KNOW say "SIMONDS"

Watch a carpenter buy a hand saw! Watch him choose a Simonds Blue Ribbon! Men who count upon cutting tools most, know that Simonds Saws hang right, that they are balanced right, and the Simonds trade-mark signifies that they are made right. For Simonds Saws are made of specially treated steel and backed by Simonds' near-century of experience in the manufacture of the finest cutting tools. Next time you buy a saw, say "Simonds" to your dealer.

SIMONDS SAW AND STEEL CO.

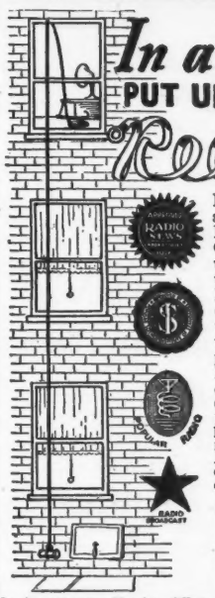
"The Saw Makers" Fitchburg, Mass. *Established 1832*

Branch Stores and Service Shops in Principal Cities

In a Jiffy-anywhere

PUT UP-CHANGE-OR TAKE DOWN

Reel Aerial



NO MORE hours wasted putting up or taking down antennas. No lead-ins to solder. No holes to drill. No tangling of wire.

Carry a 21-ounce REEL AERIAL in pocket and put up a 100% efficient aerial in a few moments—any time, any place—outdoors, indoors. Its hard drawn FLAT copper wire (¼ in. wide) can be led in under or over window or door which can be closed tight without harm to wire. Aerial can be reeled out or in to any desired length up to 100 ft. Unused portion in case does not cause dead-end losses. Place case on or near set and connect with cord which plugs into center of Reel Aerial. Order today. Satisfaction Guaranteed.

DEALERS, JOBBERS! Write for attractive literature and proposition. Use Reel Aerials in making free trial demonstrations. Sell Reel Aerials for indoor aerials, portable sets, to travelers and tourists, to experimenters and to people desiring highly efficient permanent aerials.

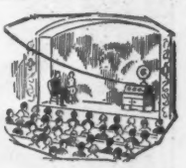
Unsurpassed as a permanent aerial. Reel Aerial has same inductance value as stranded copper wire. Being flat and smooth it is easily cleaned.

In Apartments, Hotels, Offices, Hospitals, etc.! Attach weight to insulator on Reel Aerial, and lower from window, any desired length. Bring the flat wire in between upper and lower sash and window frame--and attach to set. Or erect Reel Aerial on roof and bring in same way.

SEND THE COUPON NOW!

Experimenters, Engineers!

Attach Reel Aerial insulator to a pole and push pole into ground. Bring antenna into house. By changing distance and locations of pole, and reeling antenna in or out, you can vary antenna as desired. May also be used as permanent aerial.



For indoor aerials — can be put up around walls or reeled out on floor.

For use in halls, theatres, laboratories, schools, clubs, on trains, at fairs, etc.

Illustration is ½ size.

HERE'S 100 feet of ¼ in. wide flat, bare, copper wire, with insulator on outer end, reeled up in a handsomely nickeled metal case, 4¼ in. diameter. Weighs only 21 ounces. Fits pocket. Unreel as long an aerial as desired, place case on or near set, insert plug on cable in center hole—attach other end of cable to set—and tune 'em in. When through, if desired, reel in like a tape measure. No tangling. Provides a 100% efficient aerial in a few moments—any time, any place—indoors, outdoors. Fine for demonstrating sets on trial.

SEND NO MONEY, JUST MAIL COUPON

HAWKEYE RADIO CO. Division of Hawkeye Lightning Rod Co., Dept 1610, Cedar Rapids, Iowa.

Ship me—on your MONEY BACK GUARANTEE—one Reel Aerial C.O.D. I will pay postman $5 plus few cents postage (postage p when money accompanies order).

NAME

ADDRESS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS

RADIO PROTECTION

Sterling EQUIPMENT

Check up on these Care-Takers and Inspectors

Are you fully protected?

Pocket Meters
Panel Meters
Charge Indicators
Tube Testers
Tube Reactivators
Battery Chargers
"B" Power Units

Choose a STERLING device from the above list!

A Test in Time Saves Many an Hour of Poor Reception!

Stave off impending troubles in your set by knowing exactly what's what within your batteries and tubes. It only takes a moment to find out with the use of Sterling Inspectors. It takes only a few minutes per week to keep your set in first class operating condition with Sterling Care-Takers.

THESE INSPECTORS ARE A NECESSARY PART OF YOUR EQUIPMENT

and their cost is small compared to the troubles they avert. You don't need to be radio-wise to use them—anybody can get results, save time and money too.

At most all radio stores

THE STERLING MANUFACTURING CO.
Cleveland, Ohio

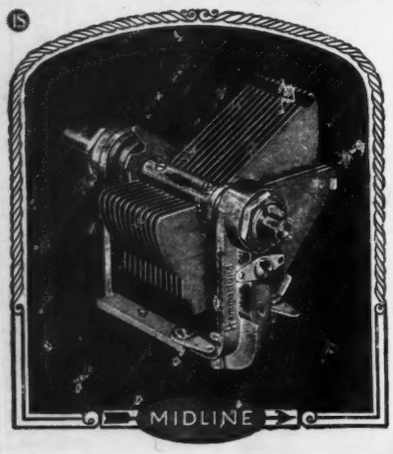
Charge Indicator
shows instantly (1) whether your "A" Battery is fully charged, (2) approximately how long it will operate before recharging is necessary, and (3), when it has been charged enough. This device tests it by the clean, quick, easy way.
Price $2.00

Tube Tester
This little meter-equipped tester plugs into the tube socket, finds a bad tube, and indicates whether any tube is "good," "fair" or "poor." Also serves as a trouble finder for entire circuit.
Price $7.50

84 Illustrated Pages of Radio Bargains!
Write for Catalog Today
RANDOLPH RADIO CORP.
189 N. UNION AV. Dept. 3 CHICAGO, ILL.

Carrying Case Given with Big 3 ft. Telescope
See people and objects miles away just like they were close; see Moon and Stars as never before. Opens over 3 ft. long, 5 sections, brass bound, powerful lenses. Useful and entertaining. "Could tell color of aeroplane 4 miles away."—Mrs. Yarbough. "Watch my boy arrive at school 2 miles away."—Mrs. Horn. "Read numbers on freight cars mile away, see mountains on moon."—A. G. Palmer. Thousands pleased.
Send No Money Write today; on arrival of Big 3 ft. Wonder Telescope with Carrying Case and Strap pay Postman only $1.85 plus a few pennies postage. Satisfaction Guaranteed.
FERRY & CO., 3224 ft. Halsted St., Dept. 1786 CHICAGO

The New Hammarlund "MIDLINE"



Condenser Will Improve Your Radio

It gives greater separation of low-wave stations than the old "SLC" type and greater separation on the high waves than the recent "SLF" type.

In addition to the many famous features in previous Hammarlund models, the "MIDLINE" has ball and cone bearings and a full-floating rotor shaft. This shaft may be removed and a longer shaft inserted for coupling to other condensers in tandem.

Made in all standard capacities—single, dual, and triple.

Sold by the better dealers.

HAMMARLUND MANUFACTURING CO.
424-438 W. 33rd Street, New York

Avoids Crowding at Any Part of the Scale

For Better Radio
Hammarlund
PRECISION
PRODUCTS

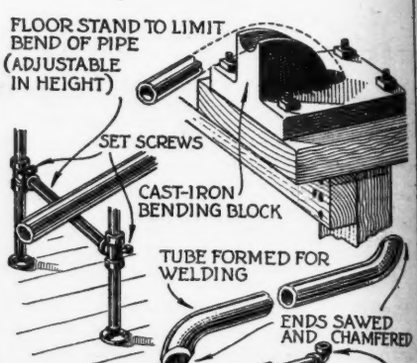
Better Shop Methods

Welding a Pipe Coil for High Pressure Work

By A. S. Jamieson

SINCE welding methods have been developed to the point where good welds can be made with certainty by a skilled welder, there is a growing tendency to do away with screwed fittings in high pressure work. This is of especial importance in heating coils used in chemical process tanks where leakage would contaminate the product.

Such a coil is shown in the illustration. It is made of 1½-in. pipe, or, preferably, seamless steel tubing. The tubes are all cut to the same length and bent with the cast-iron bending block shown, which is cast to fit the pipe, and with the desired radius. This is secured to the bench, and



The tubes are cut to length, bent uniformly, chamfered, and welded carefully endto end

on the floor in front of the bench is a pipe stand to act as a gage for the bend.

It is best to allow some extra length to saw off the ends of the pipe to a gage after bending in order to get a true fit, and a good even chamfer. When all the pipes are bent and chamfered, they are clamped together with straps and welded into what amounts to a one-piece pipe.

The finished work should be tested with hydraulic pressure, usually with the aid of a boiler test pump, to about 500 pounds.

Welding pipe is work that calls for the utmost skill in the welder's art to insure tight work. Before trying such a job a welder who has never worked on pipe should practice on some short lengths and test his work to make sure that he can do the large job satisfactorily.

A COLLET chuck for holding a small drill or a length of drill rod in a lathe may be made from a discarded lathe center. Square the end and bore and ream it to take a large taper pin. Then drill a hole of suitable size in the pin. Remove the pin and make one split lengthwise. The pin, with the rod or drill inserted, is tapped into the hole in the center.—L.B.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See Page 6.

Salesmen and Agents Wanted

AGENTS—If you write at once we can place you as our local Representative. $15 a day for full time; $2.00 an hour spare time. Exclusive territory; automobile furnished. An exceptional opportunity—investigate immediately. American Products Co., 6103 American Bldg., Cincinnati, O.

JUST out—Patented apron without strings, straps, hooks or buttons. On or off in a jiffy. Over 100 per cent profit. Commissions paid daily. Write for free sample offer. Sta-Put Co., 3210-C N. 11th St., St. Louis, Mo.

LAUDERMILK made $25 on one order, Strong $32 one day, Richardson $75 a week. Representatives with us 5-10 even 25 years. New plan of 400 premiums free with quality coffee, groceries, works wonders. Great Eastern Coffee & Tea Co., Dept. P-1030, St. Louis, Mo.

SELL new and used clothing to general Stores and Tailors. Numerous other new articles. Good pay. Young Co., Dept. P, 2549 So. Halsted, Chicago.

3 WONDERFUL Inventions! Startling plan gives customer free gold plated device making old phonograph sound like Orthophonic Victrola. Other absolishes needles. Bradley sold 36 in 36 calls. Everplay, Desk G-10, McClurg Bldg., Chicago.

NEWEST Invention! Abolishes kinks, snarls and automatically coils, telephone, electric iron and lamp cords. Housewives, business men, companies actually buying 5 to 50. Free sample to workers. Neverknot, Dept. G-10, McClurg Bldg., Chicago.

Shop Equipment

DEALERS—Buy Battery Shop Equipment and Supplies at Wholesale. Battery Charger $50.00. Adams-Barrs, Columbus, Ohio.

Stammering

ST-TUT-T-T-TERING and stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Arcade, 1126 Granville Avenue, Chicago, Ill.

Stamps and Coins

CALIFORNIA gold 8¼ size, 27c.; 8½ size, 53c. White cent and catalogue, 10c. Norman Schultz, Colorado Springs, Colorado.

STAMPS, 100. All different, 3 cents. Lists free. P. S. Quaker Stamp Co., Toledo, Ohio.

STAMPS Free—Ask for money-saving approvals. John K. Borresen, Cedar Falls, Iowa.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

NEWFOUNDLAND Stamps on approval. None better—none cheaper. Send want list and references. Rev. Butler, St. Georges, Newfoundland.

STAMP Collectors—Phillips Monthly Bulletin (illustrated) offers over 2000 special bargains, sets, packets, etc. each issue. Free. Phillips, Box 1012, Hartford, Conn.

STAMPS, 105 China, etc., 2c. Album (500 illustrations) 3c. Bullard, Station AA, Boston.

100 WAR coins $1.00, 50 foreign coins 50c, 25c–30c, Revolutionary 1776 bill 40c, 10 Confederate bills 50c, 10 large foreign bills 35c, 5 Mexican bills 35c, illustrated coin book 10c. Magy, 8-M South 18th, Philadelphia.

OLD coins, large Fall selling catalogue of coins for sale free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101B Tremont Street, Boston, Mass.

RARE Coins, Bank Notes, Stocks and Bonds, 500,000,000 Marks and price list 10c. Geo. Best, Cedar Rapids, Ia.

FREE! 12 scarce Azerbaijan to approval applicants. Mammoth Illustrated Price List 2c. Pennsylvania Stamp Co., Manor, Pa.

FINE Approval Selections at 50 per cent discount. 100 stamps free for 3c postage. Write Now. Wineholt Stamp Co., Woodbine, 16, Penna.

4 LIBERIA (two triangles) 5c to approval applicants. Patapsco Stamp Co., 4811 Ferndale, Baltimore, Md.

Technical Schools

CHICAGO Technical College offers short, intensely practical courses in Drafting and Engineering—civil, mechanical, electrical, structural—Architecture, Building Construction, Plan Reading, etc. Courses fitted to your needs. No time wasted. Instructors are experts. Graduates in demand at big salaries. Opportunities for part-time work while studying. Day and evening classes. 33rd year. Enter any time. No special preliminary training required. Low tuition—easy terms. Write for 72-page illustrated Blue Book, describing opportunities open to our graduates. Chicago Technical College, 23 Chicago Tech. Building, Chicago.

Telegraphy

TELEGRAPHY—Both Morse and Wireless—taught thoroughly and quickly. Tremendous demand. Big salaries. Wonderful opportunities. Expenses low: chance to earn part. School established fifty years. Catalog free. Dodge's Institute, H374 Hart Ave., Valparaiso, Ind.

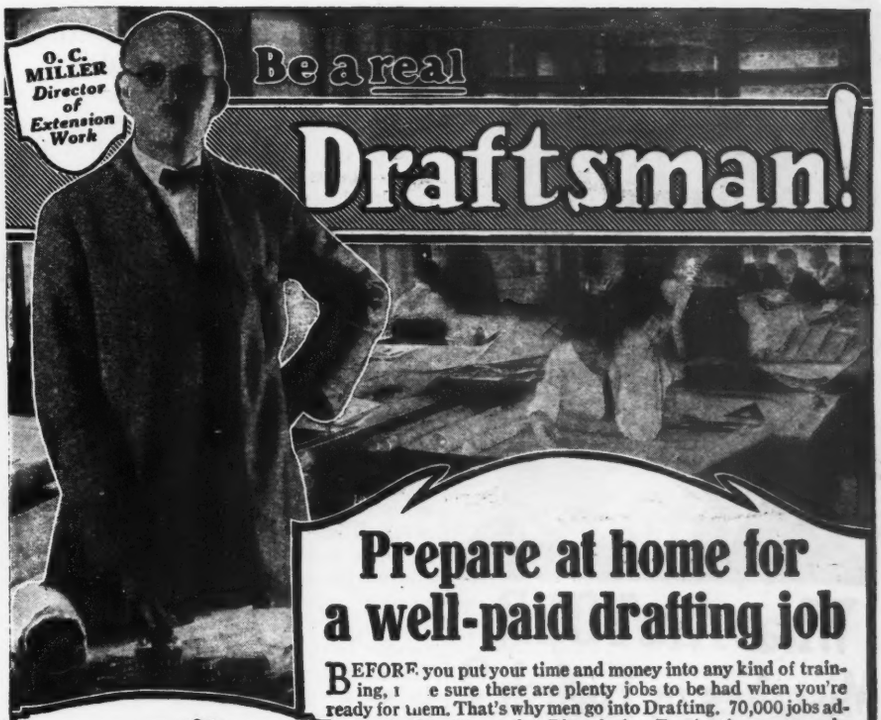
Typewriters and Supplies

TYPEWRITERS: all makes; lowest prices; 5 year guarantee; send for illustrated catalogue. Henry Typewriter Co., 217 West 125 Street, New York, N. Y.

Wanted

DETECTIVES needed everywhere. Experience unnecessary. Particulars free. Write, George Wagner, former Government Detective, 1968F Broadway, N. Y.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.



Be a real

Draftsman!

Prepare at home for a well-paid drafting job

BEFORE you put your time and money into any kind of training, be sure there are plenty jobs to be had when you're ready for them. That's why men go into Drafting. 70,000 jobs advertised in 12 months. Big salaries. Fascinating, easy work. short hours and unlimited opportunities for advancement to executive positions. Here's "white collar work" that controls all building, manufacturing, public works. Called the Ideal Profession for Men because it offers the greatest opportunities for success.

Drafting Made Easy for You

We have developed a new, one-step-at-a-time method which makes Drafting principles easy to understand. Even men with only common schooling make rapid progress with this instruction. Right from the very beginning you do actual Drafting room jobs. And by a wonderful new system you learn *without* copying, you see *why* every step is done, and so you become a *Draftsman*, not a *tracer*.

Real Draftsmen SPECIALIZE

The big money in Drafting goes to men who specialize in Machine Design, or Electrical Drafting, or Architectural Drafting, or Structural, or Automotive. It isn't enough merely to know general Drafting practice. You must know how to calculate and design and plan original work to fill the kind of Drafting position that pays $60 to $125 a week. The American School, for 29 years a leading institution teaching Engineering by home-study methods, now includes this specialized training in the complete Drafting course.

Complete Professional Outfit Given
These standard instruments, board, table, triangles, T Square, ink, protractor, etc., given without charge.

Training Backed With Nation-wide Free Job Service

The American School now offers its students and graduates, without cost, the services of an efficient Employment Department which keeps in touch with the employers of Draftsmen all over the United States. *We have placed hundreds of men in good Drafting positions.* The demand for Draftsmen in all lines at all times exceeds the supply. This is the work to get into. I will show you how, and help you make a success of it. Real Draftsmen go quickly to the top with the backing of this million-dollar Institution.

No-Profit Price
Easy Terms

This wonderful, more complete, simplified, rapid, up-to-date instruction in Drafting offered at very low tuition, easily within reach of the untrained man who needs it. Small monthly payments make it easy for you to prepare for a fine Drafting position at a big increase over your present salary.

I will make this contract with you

WHEN you enroll for my home-training in DRAFTING, I agree to give you:

1. Complete instruction by my new practice method.
2. Costly professional outfit shown above.
3. I WILL HELP YOU GET A GOOD JOB AND A RAISE IN PAY—
4. Or I'll refund every cent of your money.

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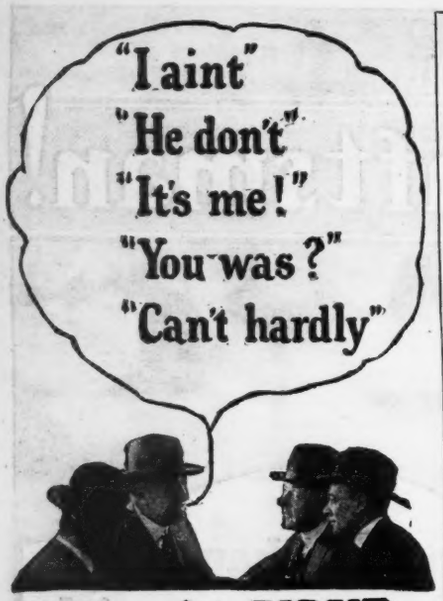

What Are YOUR Mistakes in English?

They may offend others as much as these offend you

IF some one you met for the first time made the mistakes in English shown above, what would you think of him? Would he inspire your respect? Would you be inclined to make a friend of him? Would you care to introduce him to others as a close friend of yours?

These errors are easy for you to see. Perhaps, however, you make other mistakes which offend other persons as much as these would offend you. How do you know that you do not mispronounce certain words; are you always sure that the things you say and write are grammatically perfect? To *you* they may seem correct; but others may know they are wrong.

Unfortunately, people will not correct you when you make mistakes; all they do is to make a mental reservation about you. "He is ignorant and uncultured," they think. So you really have no way of telling when your English offends others.

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Will We Hop the Ocean on Floating Islands?

(*Continued from page 13*)

least has changed in direction. With the change in direction of the force of the wave comes a corresponding opposition by the damper disks.

A somewhat similar effect can be observed in a floating water-logged hulk, which will not rise and fall in waves because the waves cannot overcome the inertia of the water it contains.

Mr. Armstrong visualizes an actual seadrome as a steel structure, 1200 feet long by 400 feet wide, or about eleven acres of surface area, with a draft of 150 feet and with the platform seventy feet above water level. In addition to the landing platform there would be two other decks and a superstructure on one side. These would contain a machine shop, a hotel and similar terminal accommodations and radio and meteorological stations. The equipment of a station would include landing lights, similar to those used on land air stations, and seaplanes and high-speed sea sleds to be employed as tenders for the planes used in trans-Atlantic traffic and for rescue work on disabled ocean vessels whose SOS might be picked up by the seadrome radio station.

THE cost of a single seadrome he estimates at between $1,000,000 and $1,500,000, which would mean that his entire project of eight seadromes placed 400 miles apart on a route of 3,600 miles between New York and Plymouth, England, would cost in the neighborhood of $10,000,000. This route would be 150 to 200 miles south of the North Atlantic shipping route, over which passes one third of the total shipping of the world. Only ten percent of the storms experienced in the regular steamship lanes would hit this route, according to the inventor, and it is also virtually free from ice and fog.

The seadromes would be moored to buoys by cables 800 to 1,000 feet long, and the buoys would be attached to 12,500-pound anchors at depths that would average 16,000 feet by two-and-a-quarter-inch galvanized steel hawsers maintained in a catenary curve, which means the curve assumed by a flexible cable of uniform section and material loaded with its own weight only. The displacement of the anchorage buoy would equal approximately the weight of the cable; the rise and fall of the ocean during storms would submerge the buoy and so minimize the anchorage strain on the cable.

MR. ARMSTRONG suggests the utilization of land planes capable of floating, rather than seaplanes, for transoceanic traffic. He has worked out a complete transportation system for 120 planes capable of making the trip from the United States to Plymouth in thirty-four hours. He estimates that 160,000 passengers would be carried in a year—about a tenth of the number now making trans-Atlantic journeys—and fixes the probable cost of passage at $350.

Mr. Armstrong (*Continued on page 145*)

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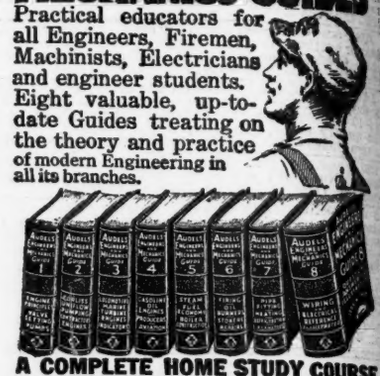

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Will We Hop the Ocean on Floating Islands?

(Continued from page 144)

minimizes the possibility of danger on his proposed air route.

"On an average you would travel two million miles in a triple-motored airplane," he said, "before you would be confronted with the necessity of making a forced landing. Anyone who has traveled in airplanes at all would not be appalled by the prospect of making a four-hundred-mile flight over water, and by my plan a trip to Europe would be only a succession of four-hundred-mile flights punctuated by stops on safe, stable, comfortable landing stations from which the journey would be resumed on planes that had just emerged from the machine shop in tiptop condition.

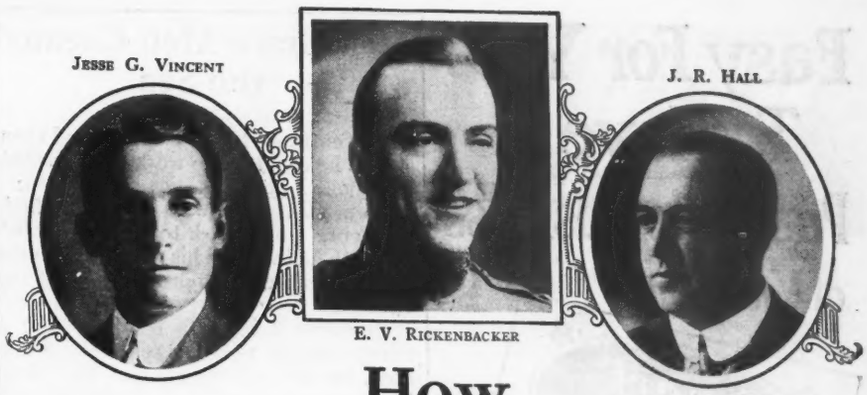
"MY proposal may seem revolutionary according to existing standards of transportation, but so has every new development in transportation seemed at first. People who were accustomed to travel by stagecoach looked askance at the railroad. Steamships frightened people who thought nothing of undertaking an ocean voyage on a sailing ship. It is only a few years ago that people feared to ride in automobiles, and the airplane is still an object of terror to many. The transition from one method of transportation to the next, however, gradually was accomplished.

"It is my belief that the trans-Atlantic airplane service I propose will establish itself in exactly the same way. People will see that with thirty-four-hour service to Europe available, they cannot afford to use steamships which require six or seven days for the same trip. It is merely a question of establishing the service, for, once established, its patronage will take care of itself.

"In this connection four groups capable of financing my scheme for ocean transit have become interested in it. As a preliminary step, and supplementing the tests I have made with the model, it is planned to construct a seadrome, somewhat smaller than the size I have indicated for ocean traffic, and place it off the coast where it might be subjected to an actual sea test."

THESE are the high spots of the amazing plan by which this inventor proposes to banish the ocean barrier that separates the Western and Eastern Hemispheres. A suggestion to dot the waters of the Atlantic with man-made islands at first glance seems bizarre, even absurd. Consider, though, that it is made by a distinguished engineer who for twelve years has instituted an average of twenty-five important developments a year, representing millions of dollars, for one of the largest manufacturing corporations in the world, and who has been a practical experimenter in aviation since the birth of the science. Moreover, he shows by mathematical calculations and working models exactly how the thing can be done.

Maybe a few years hence we'll be able to run over to Europe on week-end trips whenever we feel like it!



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JOHN MOORE—Designer of the famous Ansted Engine.

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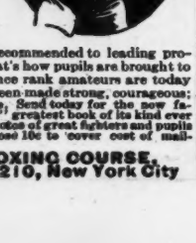

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How Brave Men Cheated the Sea

(*Continued from page 16*)

at the entrance to the tunnel. And then, before he could set to work, over Smith's telephone I heard Smith say to Eiben:

"I'm all right now, Joe. Had a little accident. Go on back to your own job."

Smith had washed his way out with the hose backward through the muck of the cave-in!

Eiben went back to his job. For a minute Smith rested; then, taking the hose, he deliberately crawled back into the clay tunnel which had almost been his grave, and for an hour more continued to wash his way toward the buried keel! Eventually the tunnel was finished, and through it were passed the chains which, attached to one of four pairs of pontoons, made it possible to float the S-51 and its crew of hero dead.

FEW records of valor on the field of battle, I believe, can compare with the bravery of this diver who returned into the black hole from which he escaped only by the grace of God. Yet his deed is typical of many performed by the divers who worked to wrest the S-51 from the sea.

The raising of the S-51 is history now. It has been called a remarkable achievement of engineering. Far more than this, it was a terrific human struggle against the power of the sea, waged by quiet men who could laugh at failure, and fight on.

In the first rounds the sea was the victor. The first salvaging expedition of the *Falcon,* with its crew of ten divers, was defeated by winter storms. There was Chief Torpedoman Frazer, the first to dive. Slipping down through a hatch into the engine room of the S-51, he closed valve after valve to seal the vessel, all the while working in sight of the bodies of S-51 engineers who died still clutching the levers of their engines. Then there were Wilson and Eiben, who, like contortionists, wriggled between machines and through narrow passageways to make air connections.

The lashing of December storms found us all but beaten; Frazer with a strained heart; L'Heureaux in the hospital fighting off death from the "bends"; Eiben crippled; Wilson a shadow; Anderson threatened with pneumonia.

AT LAST came a lull in the sea's fury. Bailey went down. A few minutes later came jerks on his lifeline, the emergency signal. Eight men seized the lifeline and hauled him up. We took off his helmet. He was almost gone. "No air, no air!" he gasped. In the icy depths his air hose had frozen solid. We dared not risk more diving. The *Falcon* went south.

With the coming of spring we began anew, more determined than ever. When the *Falcon* arrived off Block Island, we found the sea had swept away our marking buoys. For two days we dragged, until a grappling hook finally located the submarine.

Then came a heartbreaking struggle of divers to bolt on a 700-pound salvage hatch to seal the (*Continued on page 147*)

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How Brave Men Cheated the Sea

(Continued from page 146)

engine-room. Handling this mass of steel on the sloping deck of the submarine was next to impossible. At last it stuck.

With the interior of the submarine sealed up, our task then was to fasten the lifting pontoons. Under bow and stern we dragged heavy iron chains to form cradle slings. But to get the chains under amidships, we had to run tunnels through the clay in which the S-51 lay fast. It was in cutting the first of these tunnels with a fire hose that Francis Smith had the adventure already described. By the time a second tunnel was started, an ingenious machinist's mate on the *Falcon* had invented a new type of nozzle which blew backward as well as forward and which cut ten times as fast.

With chains finally in place and the pontoons floating, we were ready, late on the night of June 21, for the big lift. On the morrow we would raise the submarine.

BUT the next day a storm broke. Suddenly the sea boiled under the *Falcon*. A moment later, the bow of the S-51, torn from its bed by the waves, came bursting through the surface riding on four pontoons. Breakers crashed over her, and the pontoons pounded each other madly.

It was up to us now to raise her the whole way, storm or no storm. We began pumping air into the stern pontoons. Something slipped. Chains snapped, and two pontoons drifted away. Our chance was gone. We had to sink the bow pontoons before they, too, should be torn away by the storm.

But in thirteen days we had replaced the pontoons. Then compressed air began to flow into the engine room and stern pontoons. Less than two hours later the stern rose in a foaming sea. Now all the air was poured into the forward pontoons, while the divers lined the rail, tense and anxious. An hour passed. Four of the forward pontoons were dry, but still no sign of motion. The last two were nearly dry; still no sign. The suspense became terrific. Suddenly my indicators told me that the bow was rising. I hurried to the rail. Still no sign, but I needed none now.

"Gentlemen," I said, "here comes your bow!"

Great geysers shot up as six pontoons broke through the foam. The S-51 was afloat. We flung our caps into the sea.

FOR 150 miles a strange procession moved through Long Island Sound with the S-51 in tow. At the top of the morning tide we arrived off New York. Just as we caught a glimpse of the navy yard entrance, there came a jolt. The S-51 leaped violently, then stopped dead. Our pilot had stranded us on a reef!

For the last time we renewed the battle, and when high tide came again we floated the submarine clear.

So, in the end, we berthed the S-51 safely in dry dock. So we brought the navy back its ship, and the families of her crew their beloved dead.

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New Wonders of Our Sun

(*Continued from page 18*)

turbing periods have their compensations. Sunlight now is being advertised as one of the greatest curative agents at the disposal of man. The ultra-violet rays are known for their health-giving properties, and have been found particularly beneficial in the treatment of rickets and tuberculosis. Experiments have revealed that during his periods of activity the sun is unusually generous in his distribution of the ultra-violet rays.

DESPITE the distance that separates us from the sun, he can't hide many of his secrets from us. We know, for example, just what he is made of. And all of his chemical constituents have been found on earth with the exception of one, coronium, which is revealed during an eclipse. The fact of this duplication gave rise to a theory recently expounded by Professor John A. Snyder, of the Philadelphia Observatory, that the earth is an offshoot of the sun.

Away back a few billion years or so the sun, he tells us, was much more active than at present. A great boiling motion is kept up in the interior even now—the heat at the center is estimated to be around 70,000,000 degrees—and there is reason to believe that in its youth the sun was much hotter and more active. When the earth came into being, Professor Snyder thinks, there was an eruption similar to that which occurs in many homes daily at breakfast time when the housewife lets the coffee boil over. The sun got beyond its boiling point and a spot, or volcano, formed on its surface. The force was so great that a small portion of the interior shot out and went sailing in a curve through space, much as the coffee shoots up and over the side of the pot.

ON AND on this segment of gas flew, gradually slackening speed and describing a great arc as the normal attraction of the sun worked to offset the force of propulsion. When the particle had reached a distance where the two forces were equal, it lost its motion away from the parent and continued on its curve. Gradually it cooled, formed a crust, and settled down to the task of making itself habitable for humans.

Professor Snyder believes there was a recoil when the earth was shot off, and that a hole was torn in the opposite side of the sun's outer layer. Another segment was tossed out, becoming in time the planet Venus.

It really seems a shame to let the sun's energy go to waste. It is estimated that the amount of heat generated every second has a mechanical equivalent of 20,000 billion horsepower, sufficient to do all the work of the world. If there were only some way in which that energy could be harnessed we should not have to bother digging coal and drilling oil wells. Just snap on a switch and the sun would do the rest.

Our knowledge of this great orb would be much greater were it not for the fact that we have, on the average, only a minute or two a year (*Continued on page 149*)

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New Wonders of Our Sun

(Continued from page 148)

in which to study it carefully. That is during an eclipse. Only then is the corona, an immense halo many thousands of miles in diameter, visible. It was during one of those momentary periods that the existence of helium was discovered. Scientists then succeeded in manufacturing helium, and eventually it was discovered on earth.

The corona is irregular in shape. Mountains of leaping light which form the outer edge reach heights of 35,000 miles and more. It is believed these prominences have a direct connection with the sun spots, hence the eagerness with which they are examined.

AN ECLIPSE, as you know, results when the moon gets between the earth and the sun. Were it not for a peculiar coincidence in the mathematical scheme of the heavens, eclipses would be of little value to the astronomer, as far as observation of the corona is concerned. The diameter of the sun is 400 times that of the moon, but its distance from the earth is also about 400 times that between earth and moon. The result is that when the moon passes directly across the sun's face the latter is completely obscured to persons whose location on the earth's surface is in the resultant shadow.

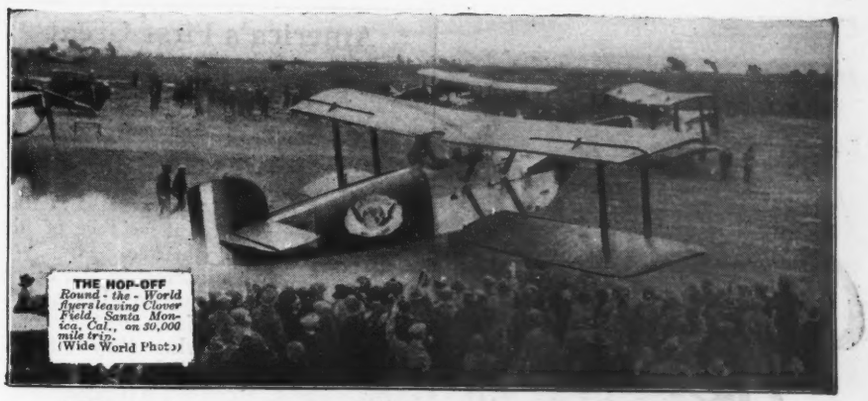
Just try this little experiment, and you'll see how it works. Your radio cone speaker, a dish pan, or plate can be used to represent the sun. Cut a circular disk of cardboard one inch in diameter to represent the moon. Now, assuming that your speaker or plate is eighteen inches in diameter, pace off eighteen feet from it and hold the disk before one eye, closing the other. Extend it slowly in the direction of the speaker until you have reached a point where the edge of the latter begins to appear. If you will have another person measure the distance from your eye to disk you will find it is exactly one foot.

THAT experiment represents a total eclipse. There are two other kinds—annular and partial. If, from the place where you have secured a total eclipse, you move your arm still further out in the direction of the speaker, you will be able to make out the rim. That illustrates an annular eclipse, while a partial eclipse can be demonstrated by moving your hand a little to the right or the left, so that one side of the speaker is visible while the other side is concealed.

Scientists travel thousands of miles and spend months in the erection of great cameras just for a view of an eclipse that may last only a moment or two. Universities and scientific societies spend many thousands of dollars in equipment. It is estimated that the cost of each eclipse expedition is about $10,000 a minute.

When it is all over the photographic plates are developed and examined carefully for new signs. If one little bit is thereby added to our knowledge of the sun these investigators feel well repaid for their time and trouble.

Meanwhile the sun beams down, seeming to indulge himself in a sardonic smile at the puny efforts of men to discover his source of energy.



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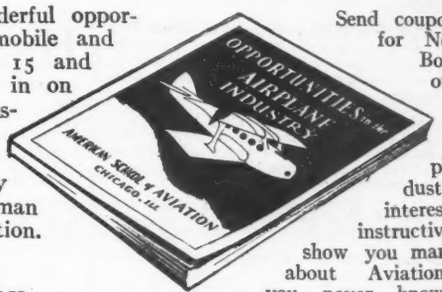

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America's First Great Experimenter

(Continued from page 24)

are "warming, dieting, and bracing." His suggestions, made in an era of "copious bleeding," all point toward today's theories of preventive rather than curative medicine—a typical instance of his position in advance of his age.

Great as was his interest in the other phases of science, Franklin always displayed a lively enthusiasm for the social sciences, particularly where they touched upon the sciences of political economy or of government. Some of his comments on population are particularly interesting in the light of today's knowledge. Consider this one:

"If in Europe they have but four births to a marriage, we may here, in America, reckon eight."

"Now (1751) one million English souls are in North America. This million, doubling once in every twenty-five years, will in another century be more than the people of England."

Similarly, his views on immigration show amazing foresight.

"MANY persons," he wrote, "have expressed their desire of transporting and establishing themselves in North America, but who appear to have formed, through ignorance, mistaken ideas and expectations of what is to be obtained there. . . . It may be useful, to prevent inconvenient expense and fruitless voyages, by giving some clearer account . . ." Such a paragraph might easily be included in the remarks of any immigration official today.

But he remained thoroughly human, in the midst of all his higher branches of learning. At any moment he was apt to set himself some such question as, "I am about courting a girl I have but little acquaintance with. How shall I come to a knowledge of her faults, and whether she has the virtues I imagine in her?" To which he suggests the answer: "Commend her, among her *female* acquaintances!" No modern psychologist offers more.

HE WAS by no means always right in his conclusions. Thus he did not recognize the true nature of phosphorescence in sea water, but linked this up in his mind with the sea as the home of lightning. However, after he had, in his careful way, examined sea water under a microscope and seen its myriad organisms, he was willing to accept a new theory. This was characteristic of him.

Something that seems much less characteristic is that he was for a time a soldier. Almost anyone would think of him as distinctly a man of peace. Yet, when a Philadelphia regiment of militia was dispatched to fight the Indians, Franklin, in spite of some disinclination, rode at its head as Colonel.

What is more, he soon showed that a certain amount of military science was included among his attainments. Distributing his detachments, he built several forts with palisades and moat trenches, with loopholes and gun emplacements. As the axes began felling the necessary trees, he *(Continued on page 151)*

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America's First Great Experimenter

(*Continued from page 150*)

made a point of noting that it took "six minutes by the watch" for two men to bring down a pine "of fourteen inches diameter." And that he was equally careful in not neglecting the personnel of his command is shown by his method of getting men to come to prayers.

The regimental chaplain, finding his audiences small, complained that the enlisted men were not punctual. Colonel Franklin had noticed that they were, however, very punctual when the allowance of rum was served out. "Perhaps," he said to the chaplain, "it is below your dignity to act as steward of the rum. But if you were to deal it out, and to do so only after prayers, you would have all the men about you." The experiment was tried and, says Franklin, "never were prayers more generally and more punctually attended. I thought this method preferable to the punishment inflicted by military law for non-attendance."

ANOTHER public act of his justifies his lifelong application of psychology and proves his absolute mastery of unequivocal, exact language. This occurred in 1776.

We have just celebrated the centenary of the death of Thomas Jefferson and the sesquicentennial of his masterpiece, the Declaration of Independence. Jefferson's original rough-draft was examined for the first time under a microscope when President Harding ordered the smooth, official copy moved from the State Department to the Library of Congress for public exhibition. Then Franklin's unsuspected share in the historic document was revealed.

Like Jefferson, he was a member of the Committee of Five appointed to draw up the Declaration. But Jefferson's well-earned reputation for a beautifully polished pen made it inevitable that he should be chosen to do the actual writing.

"WE HOLD these truths to be sacred and undeniable." That, as Jefferson wrote it, was the phrase; smoothly rounded enough. But to Franklin, the phrase was too long to be emphatic, and too general, because it was applicable to any truth, wherever found. Would any body of men, prepared to "hang together or hang separately," pledge "their lives, their fortunes, and their sacred honor" for any truths so vaguely introduced? Franklin thought not.

There is no written record that he reasoned in this way, but there is a very definite record—proved by the microscope—of his conclusion. Let anyone read the original aloud, as Jefferson put it, and then do the same after Franklin had taken up his quill, crossed out the last three words, and left behind him, for all time: "We hold these truths to be *self-evident!*"

Living in the eighteenth century, Franklin used its dignified English. But he was fully awake to the value of what we, in the twentieth century, call "punch."

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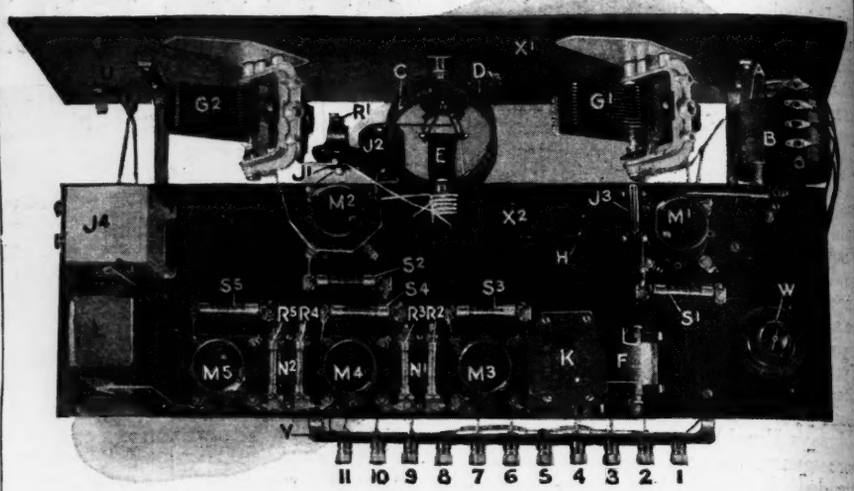
A Powerful New Five-Tube Set

(*Continued from page 59*)



Be Careful to Place Tuning Units Exactly at Right Angles

Fig. 5. This illustration shows you how to arrange the parts. The tuning coils are well spaced from all other parts so that no losses are introduced into the radio-frequency circuits

culty in this way, do not hesitate to write to POPULAR SCIENCE MONTHLY for information or advice. The list of radio apparatus approved by the Popular Science Institute of Standards will prove a help in selecting reliable parts.

Be sure to purchase a standard type of radio cabinet large enough for the 7 by 24 inch front panel and 10 inches deep before you do any work on the set, because the first construction job is to cut off the subpanel to the proper length to fit into the cabinet and then fit it to the front panel by means of two brass right-angle brackets bent up from strip stock. The front edge of the subpanel should be three inches from the front panel and the top surface of the subpanel should be about 1⅞ inches above the bottom edge of the front panel. Remember that the balancing condenser *H* projects below the panel, so be sure to mount the subpanel high enough to provide clearance for this condenser. If you have the subpanel too high, however, the top of the cabinet will strike the vacuum tubes.

Take these factors into consideration when you are buying the balancing condenser *H* and the tube sockets.

NOW cut an opening in the back of the cabinet for the binding post panel after you have fitted it to the subpanel. After that you can nail in the wooden supporting strips at each end of the cabinet. A careful study of the illustrations will show you how this should be done. Full details are given in the blueprints.

The factory-made tuning unit *A*, *B* is mounted easily on the end of a 2-inch No. 6-32 brass screw as shown in Figs. 1 and 2. Be sure that coils *B* and *D* are set exactly at right angles, as illustrated.

MOUNT the sockets *M1* and *M2* with the *G* and *P* terminals toward the front panel, and place sockets *M3*, *M4* and *M5* with the *G* and *P* terminals close to the rear edge of the subpanel. This puts all of the filament terminals of the sockets near the center of the subpanel and the self-adjusting rheostats wired to them.

The audio transformer *K* should be set with the *G* terminal next to the *G* terminal of socket *M3*, and the resistance-coupling mountings *N1* and *N2* should be placed with the (*Continued on page 153*)

Fig. 7. The knob at the left controls volume. The knob in the center regulates regeneration—it is not used except for distant stations

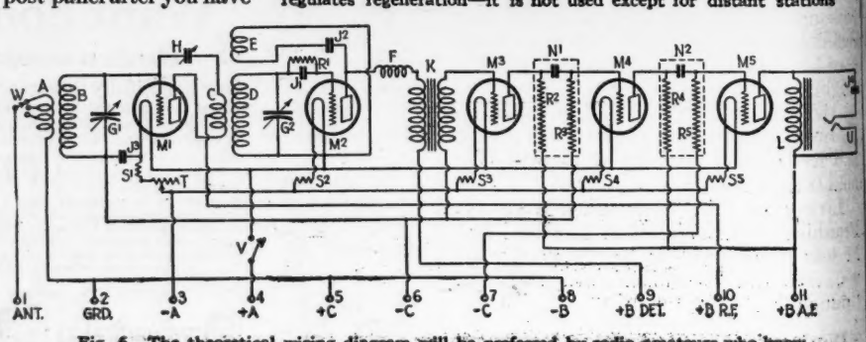


Fig. 6. The theoretical wiring diagram will be preferred by radio amateurs who know the meaning of radio symbols. All parts are lettered as in the picture diagram of Fig. 4.

A Powerful Five-Tube Set

(Continued from page 152)

P and *G* terminals toward the back of the set, where they will be as close as possible to the *G* and *P* terminals of sockets *M3*, *M4* and *M5* so that the connections will be short.

It is desirable also to mount by-pass condenser *J4* with the terminals toward the end of the set away from the tuning units so that they will not be too close to the variable condenser *G2*.

You will find that No. 6-32 brass machine screws and nuts are fine for bolting the various parts to the subpanel, and a No. 25 drill will make a hole with just enough clearance so that you will have no difficulty in assembling. A smaller drill can be used for the holes through which the connecting wires are passed. Study the illustrations and wiring diagrams carefully so that you will be sure to drill all of the holes needed for the wiring before you start assembling the instruments.

When everything is bolted in place, you will be ready to start the wiring.

THE filament wiring should be put in first. Run a wire from binding post No. 3 to one terminal of rheostat *T* and to self-adjusting rheostats *S2*, *S3*, *S4* and *S5*. Then connect the remaining terminal of rheostat *T* with one terminal of self-adjusting rheostat *S1*. Now connect the remaining terminal of *S1* to the nearest filament terminal of socket *M1*, connect *S2* to *M2*, *S3* to *M3*, *S4* to *M4* and *S5* to *M5*. You will note from the illustration of Fig. 5 that the self-adjusting rheostats are placed so that one terminal of each is close to the socket terminal to which it connects.

Now connect all the remaining filament terminals of the five sockets together and to one terminal of filament switch *V*. Connect the other terminal of filament switch *V* directly to binding post No. 4. This completes the filament wiring that

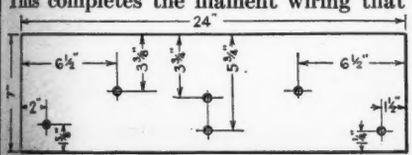


Fig. 8. Here is the panel layout for the new set illustrated in Fig. 7. Only centers are given

carries the current from the A-battery to light the tubes. The case of the audio by-pass condenser *J4* should be grounded to the filament wiring at the nearest convenient point. The way to do this is to put a soldering lug under one of the nuts that bolts *J4* to the subpanel and run a wire from this lug to the nearest point on the wire that is connected to binding post No. 3.

YOU will find that the simplest way to make connections from several instruments to the same wire is to solder the ends of the wire to the two terminals that are farthest apart and then run branches through the holes in the subpanel to the terminals in between.

Next connect binding posts Nos. 2, 3, 5 and 8 together and then run a wire from binding post No. 9 (Continued on page 154)

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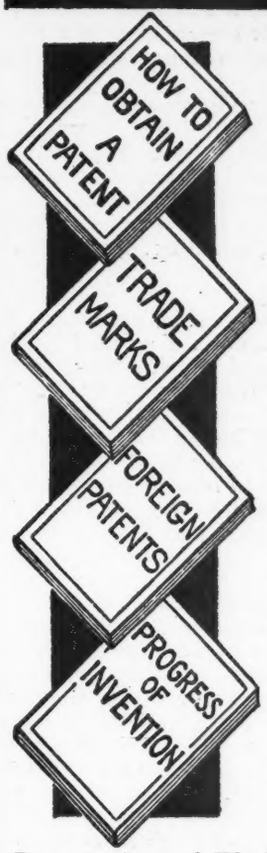

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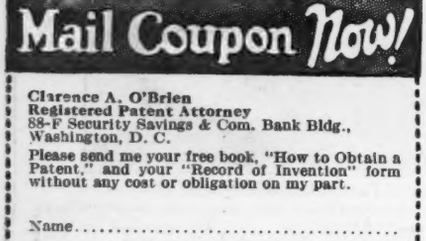

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A Powerful Five-Tube Set

(*Continued from page 153*)

to the *B* terminal of audio transformer *K*. Then run a wire from binding post No. 10 to the center tap of coil *C* (this is lug No. 2 on the commercial type tuning unit).

Now run a wire connecting up binding post No. 11 with the *B* terminals of resistance-coupling mountings *N1* and *N2*, one terminal of audio blocking choke *L* and one terminal of jack *U*.

Next connect the *F* terminal of resistance-coupling mounting *N2* with binding post No. 7.

RUN a wire from binding post No. 1 to the switch arm of switch *W*. Then connect one end of coil *A* and the two taps (these are lugs Nos. 2, 3 and 4 on the commercial type unit) to the contact lugs of switch *W*. Connect the remaining end of coil *A* (this is lug No. 1 on the commercial unit) to binding post No. 2 by way of the wire from rheostat *T* that goes directly to binding post No. 3, which you have already connected to binding post No. 2.

Now connect the end of coil *B* (this is lug No. 5 on the commercial type unit) that is farthest from the front panel with the *G* terminal of socket *M1*, and run a branch from this wire to the stationary plate connection of variable condenser *G1*. Then connect the other end of coil *B* (lug No. 6 on commercial unit) with the rotary plates of the condenser *G1* and continue this wire under the subpanel to binding post No. 6, with branches going to the *F* terminal of transformer *K* and the *F* terminal of resistance-coupling mounting *N1*. Connect one terminal of by-pass condenser *J3* to this wire and the other terminal of *J3* to the nearest filament terminal of socket *M1*.

Connect the stationary plates of balancing condenser *H* with the *G* terminal of socket *M1*, and run a wire from the rotary plates of condenser *H* to the lower end of coil *C* (this is lug No. 1 on the commercial tuning unit *C*, *D*, *E*). Then connect the other end of coil *C* (lug No. 3 on commercial unit) with the *P* terminal of socket *M1*.

NEXT connect the lower end of coil *D* (lug No. 4 on the commercial unit) to one terminal of grid condenser *J1*, and connect the other terminal of condenser *J1* with the *G* terminal of socket *M2*. Connect the stationary plates of condenser *G2* to the coil end of condenser *J1*. Make these connections just as short as possible.

Now run a wire from the upper end of coil *D* (lug No. 5 on commercial unit) around socket *M2* and solder it to the rotary plate connection of condenser *G2*. Drop a branch from this wire to the filament terminal of socket *M2* that is connected to switch *V* if you intend to use a 201A type tube as a detector. If you want to use the new 200A type detector tube, make this connection to the filament terminal of socket *M2* that is also connected to the self-adjusting rheostat *S2* instead of to (*Continued on page 155*)

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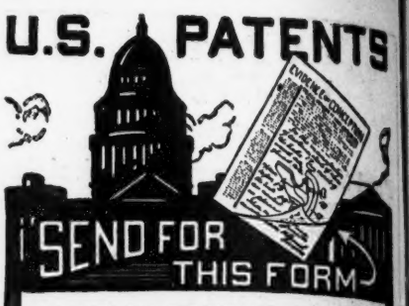

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A Powerful Five-Tube Set

(Continued from page 154)

the positive terminal. If at any time you decide to change tubes, be sure to remove one wire before you put in the other, as otherwise you will have a short circuit that will result in burning out the self-adjusting rheostat *S2*.

Connect one terminal of radio-frequency choke *F* to the *P* terminal of socket *M2*. Connect one terminal of by-pass condenser *J2* to this same wire, and connect the other terminal of *J2* to one terminal of tickler coil *E* (lug No. 7 on the commercial unit). Connect the remaining terminal of coil *E* (lug No. 6 on the commercial unit) to the wire that goes from filament switch *V* to the filament terminals of the tube sockets.

NOW connect the remaining terminal of choke *F* to the *P* terminal of transformer *K*. Connect the *G* terminal of transformer *K* to the *G* terminal of socket *M3*. Connect the *P* terminal of socket *M3* with the *P* terminal of resistance-coupling mounting *N1*.

Then connect the *G* terminal of *N1* with the *G* terminal of socket *M4*, the *P* terminal of socket *M4* to the *P* terminal of *N2*, the *G* terminal of *N2* to the *G* terminal of socket *M5*, and connect the *P* terminal of socket *M5* to the remaining terminal of choke *L* and one terminal of condenser *J4*. Connect the remaining terminal of *J4* with the remaining terminal of jack *U*, and the wiring is complete.

After you have finished the wiring, be sure to check your work at least twice to be sure that there are no errors.

To put the set into operation, connect up the antenna and ground to binding posts Nos. 1 and 2. Connect a 6-volt storage battery to binding posts Nos. 3 and 4. Connect the minus end of the B-battery to binding post No. 8. Apply 45 volts to binding post No. 9. Connect up 90 volts to binding post No. 10, and 157½ volts to binding post No. 11 if you use the 112 type power tube in socket *M5*, or 180 volts if you use the 171 type power tube in the last socket.

THE plus terminal of the C-battery should be connected to binding post No. 5. Use 4½ volts C-battery on binding post No. 6, and 9 volts on No. 7 with the 112 tube, or 40 volts if you use the 171 tube.

Using the 171 tube and the battery voltages given above, the set uses 5 mils of current. With the 112 tube it uses 8 mils; and if you use 201A tubes throughout, the current consumption is only 5 to 6 mils.

In the next issue, in the Home Workshop section, there will be a second article, covering the fine points of balancing this model five-tube set. The use of various combinations of tubes and other important details showing you how to get the best results will also be explained.

Remember that if there are any details of the construction or the wiring of the receiver that do not seem clear, the staff of POPULAR SCIENCE MONTHLY *will be glad to answer questions.*

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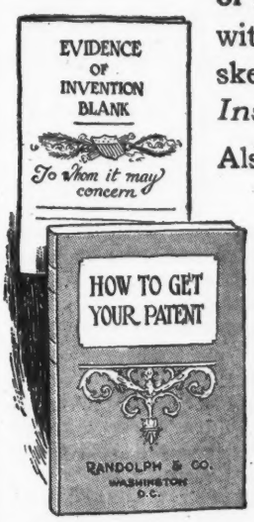

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My Life Wasn't Worth a Dime—

(Continued from page 29)

a long native knife, which Momadu had thrown wildly to me, fell at my feet. I grasped it and brought it down on the snake's head, warding him off, stunning him. His capture was easy after that.

People frequently confuse the spitting snake with the constrictor. Cobras spit—a poison secretion which will kill a man shortly, if it enters his blood stream. The spitting, venomous snakes never constrict, whereas the python, that does not hurl its poison, is a constrictor, and once within the coils of its magnificent length of body the man or animal is doomed.

A COLLECTOR of snakes must know where the snakes hunt, and that sometimes takes years. Twenty years ago and more, the Bronx Zoological Gardens of New York gave me an order for several kinds of rare snakes. They wanted green mambas—the long bright green, whiplike snake that winds itself about a tree branch, head down, and bites you as you pass under. They wanted the horned rhinoceros viper, and they wanted the ball python—the snake which curls into a ball on the approach of man.

Though I have agents in various parts, and each year take a trip into some foreign country, twenty years and more passed before I was able to bring these three snakes home.

Folks at home probably think an animal man in West Africa flings himself out of one peril into another day by day. He doesn't. He can go for long weeks having all his animal forays turn out like shoes from a factory, clocklike and ordered. Then comes the hot moment when he looks on death and wonders why he ever left his home in Camden.

IN THE West African country, once, a great granddaddy crocodile had been terrorizing the natives. An old chief, whose daughter had been eaten by the reptile, sent for me. Out there I'm supposed to catch animals by witchcraft. Well, I built a spring trap by bending down tree branches. When the giant crocodile was finally lured to the bait, he released a set of springs, and his foolish head, bound within a stout noose, went up into the air, tied to a tree branch. I had figured that the crocodile would be entirely suspended, so we could drop him into a cage and take him alive. But he was so heavy that my plan didn't work.

He was lifted about ten feet, leaving several feet of his enormous tail switching on the ground. With one rush the tail struck a black boy and killed him. In the next moment it knocked me down, but I was up again instantly and had to dispatch the rascal with my elephant gun.

Each year when I set sail for Africa my friends ask me, "Well, Pa Buck, when do you stop traveling and retire? Aren't you getting a bit weary of this wild animal game?"

I answer them all: No man, with curiosity in his mind and sympathy in his heart, can ever tire of wild animals.

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Mistakes to Avoid in Placing a House

(Continued from page 32)

seeding, have the slope covered with squares of cut sod. Some difficult terraces are planted with shrubs whose roots keep the soil from washing away.

"As for a retaining wall, don't build it without a concrete foundation going below the frost line. Make it plenty thick and strong above ground, always of concrete or cement-bonded masonry. If earth presses against the wall on one side, better reinforce the job with steel rods running both ways and put some draintile through the wall."

"Do we have to be fussy about our house foundations?" demanded Ellen. "Isn't it an old-fashioned idea that the underground part must be just so?"

"YES, it is as ancient as the Scriptures, which refer to a certain dwelling which was built on the sands. Until the day when a house can be suspended from balloons or made to float in the ether, it will need the old provision of a stable base. Why? Because frost and water are insidious enemies that attack houses below ground, make them lean and settle, crack plaster and skewgee doors, rot sills and floor beams, and at last destroy them utterly.

"Whether there is a cellar or not foundations should always go below the frost line to rest on firm soil. When a cellar is dug five to seven feet down, it is pretty certain the bottom is hard and suitable for the foundation. Most any below-frost bottom will do. Beware only of marshy or filled-in ground or a site near a river, say, where water may wash the soil from your foundations.

"Sometimes you can save a couple of feet of digging and have a higher, drier house by outside grading, that is, banking earth around the outside walls. You see, raising the outer level is the same as deepening the inside. Of course you should not bank too steeply, for looks and other reasons."

"How thick should we make the foundations, and of what material?" asked the young husband.

"AT THE very bottom you have a concrete footing sixteen inches wide and a foot deep. On the center of the footing you put up the walls, whether poured concrete, brick or stone masonry, or concrete blocks. The local building code may require a twelve-inch wall up to grade or outside ground level but eight-inch thickness is enough in anything except rubble masonry. The latter needs to be a foot or more thick, because it includes large stones and does not make a strong, tight job in thin sections.

"Often a builder uses loose stones that he digs up to fill concrete forms, thereby saving cement and money. If such stones are used, they should at least be clean, not too large and so placed that their ends don't touch the form boards."

"You haven't said which material is best for the foundation," commented Ellen.

(Continued on page 158)

. . . . . and perhaps you, like other ambitious men, due to the lack of money, time and education necessary to master *difficult* mechanical trades, wonder what *you* can get into *quickly* and make the most out of, *now!* Haven't you *overlooked* the very thing you are looking for? For *there is* a profession begging for clean-cut, *earnest* men, like yourself! *Look into it.* 60,000 Moler graduates *know* Modern Barbering is easy to learn, inexpensive, *quicker* to earn, *clean* and FASCINATING! It pays *better* than you think! FIND OUT! Write for booklet C10.

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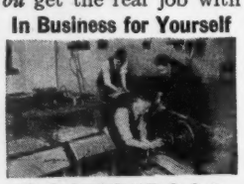

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Mistakes to Avoid in Placing a House

(Continued from page 157)

"Poured concrete is standard," was my answer. "It has to be done well to maintain its reputation. Footings and walls can be made in one operation, and if a power mixer cleans up the job in one day you have a seamless monolithic base for your home. A mix of one part cement, three parts sand and five of gravel or crushed stone will be right in most cases."

"What do you say to foundations made of concrete blocks?" asked Rob. "They're quite common, I notice."

"Yes, and they do very well. It's largely a question of local conditions whether to use blocks or poured stuff. Blocks are convenient to handle, require no form or mixing labor, and are easily laid up. They are not so good in a damp site because to make them water-tight you have to coat the outside with hot tar and maybe also plaster the inside with a rich cement mortar. But an inferior poured wall may require the same treatment.

"SIZE up the location in choosing your foundation material. A deep cellar will have more water trouble than a cellar not far down. If springs appear in the excavation, that's a hint to use first-class solid concrete."

"I guess the cellar floor needs to be made by a concrete chef, as well as the walls," said the young fellow.

"It deserves the faithful workmanship of my Italian friend, Carmino. He can make you a bone-dry floor, smooth as polished stone, having gentle slopes, imperceptible to the eye, to lead any chance water away to the trap drains. His method is first to level the earth. Then he lays the tile drain lines, if these are required. He fills the whole area with six inches of hard cinders and tamps them down well. He then applies about three inches of rough concrete and gives it slope with line, straight edge and level. He finishes the top with an inch of rich cement mortar, on the damp surface of which he sprinkles a little dry cement before troweling.

"WHILE Carmino uses the spirit level, his eye is about as reliable an instrument. It is certainly more artistic. When an argument arises between his eye and his level, he gives the benefit of the doubt to the former, with beautiful results."

"If your Carmino is a real person, I want him to work on our house," exclaimed Ellen enthusiastically.

"I'll show you examples of his art on my place. He is only one of quite a number of good craftsmen in the building line. I guess everybody is beginning to appreciate the merit of artists, even though they wear overalls. In New York lately they awarded a medal to a hod carrier for deft and devoted performance."

"I'll bet he deserved it more than some birds do their honorary degrees from colleges," said Rob.

Next month—another article to help you with your home building problems.

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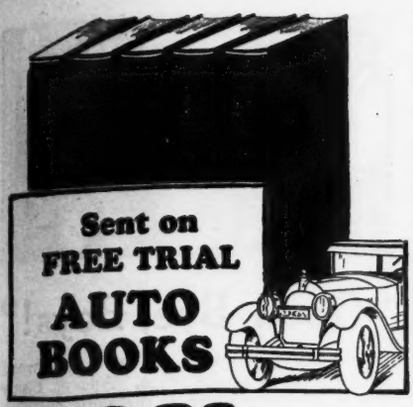

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Read Interesting article on Page 4. "How $100 a Month, Invested Properly, Can Make You Independent."

Magic Things We Do With Glass

(Continued from page 35)

the form of a flat plate and then carefully polishing both surfaces so that they are absolutely parallel.

If you should visit a glass factory, as I did not long ago, you would see that the method of making blown glass is much the same in essential principles as it has been for centuries past, except where modern machinery has been substituted for hand labor. In fact, if an ancient Egyptian glassmaker should come back to life and get a job in a modern plant where common window glass is made by hand, he would be able to pick up a "blower's pipe" and earn his wages with little trouble. Watch how it is done:

Before a large glass kiln, in which sand mixed with powdered limestone and sulphate of soda has been melted, stands a worker known as a "gatherer." In his hands he holds a hollow iron "blower's pipe," some five feet long. He dips one end of the pipe in the melted glass until a solid ball of the material adheres to it. Near him stands another worker, a "blower," the floor in front of him cut away and disclosing a deep trench, known as a "swing hole."

THE gatherer passes the pipe to the blower, who raises it and blows into it until the soft glass at its other end expands into a pear-shaped bubble. The bubble is reheated, and then the blower lowers it into the swing hole, where the weight of its lower end causes it to elongate and take on cylinder form.

Now the blower fills the cylinder with air from his lungs and stops the mouthpiece with his thumb as he once more thrusts the end of the cylinder into the furnace. The imprisoned air expands, and bursts through the softened end. The blower again lowers the cylinder into the swing hole, this time whirling the pipe between his hands. This whirling motion causes the glass to assume true cylindrical form, with sides parallel and of fairly uniform thickness.

NOW the "neck" where the glass adheres to the blower's pipe is cut off, the cylinder divided into sections or "shawls," and these sections cut lengthwise. These shawls now are placed on a flat surface in a flattening oven, where the heat causes the glass to "wilt" gently, and to open out into sheets. Finally the sheets are cooled, after which the window glass is ready to be washed with acid, graded, and packed for shipment.

In principle the process of making window glass by machinery is the same, I found, but more spectacular. A giant machine dips compressed air blower's pipes into the glass kilns, and then withdraws the pipes slowly. As they are raised high into the air, the adhering glass is blown into mighty, gleaming columns. The machine-blown glass cylinders are as much as forty feet long and two feet in diameter!

The manufacture of plate glass I found equally fascinating. The sand is melted in gigantic "pots." *(Continued on page 160)*

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Magic Things We Do with Glass

(*Continued from page 159*)

Another flower in the Harvard collection—Echinocereus Engelmanni. From the sharp spines to the delicate petals, all is blown glass

These pots are removed from the ovens by electric cranes, and their contents spilled over steel casting tables, where the glass is rolled flat by twenty-five-ton steel rollers. Finally the rough plates are cooled, ground and polished to half their original thickness.

It is possible that the historic method of making glass from sand eventually may give place to new and radically different processes. Just a few weeks ago, for instance, chemists at Cornell University announced the discovery of a way to make sandless glass by using a compound of the metal called germanium. For the present, however, the white, hard grains of sand still remain the commonest material for glass manufacture.

Perhaps the most fascinating of the art, to me, had to do with the coloring of glass. In many cases, glassmakers told me, desired tints had been obtained only by pure accident. For example, the red glass in the tail-light of your car came from the discovery by a French scientist that ruby glass of remarkable transparency and radiation could be colored by selenium, then a waste product.

ANOTHER chemist, by throwing a little salt into a glass melting pot, a score of years ago, hit upon the discovery of a glass for lampshades that would produce a white light without glare. The same chemist was instrumental in producing almost perfect reproduction of natural daylight for the stage by the combination of red, green, and blue spotlights.

If you are particular about the exact color of your necktie, you probably carry your choice to the store door to see it by daylight—or else use the "daylight lamp," which glass has made possible. The bulb is made of light navy blue glass which absorbs those rays which give ordinary artificial light a yellowish tinge.

Usually the coloring in glass is produced by mixing rust of various metals with the clear glass. Thus chromium produces chrome green or yellow; manganese, violet; cobalt, purple-blue; ferrous oxide, olive green or pale blue; lead, pale yellow; tellurium, pale pink; nickel, violet or brown; copper, peacock blue or green.

"Good Bye, Boys!"

"To-day I dropped in for a last word with the boys at the office. And as I saw Tom and Dave there at the same old desk it came to me suddenly that they had been there just so the day I came with the firm four years ago.

"When I started here I was put at a desk and given certain routine things to do. But after a few months I began to realize that I was nothing but a human machine and that I couldn't expect to advance that way.

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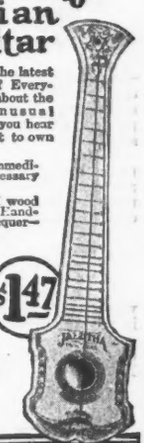

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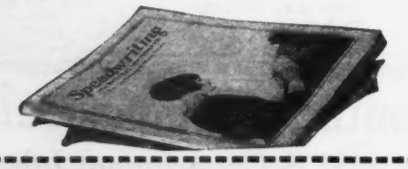

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This Modern Atlas Lifts Tons With His Head

(*Continued from page 39*)

a nightmare or two. The stack was one hundred and thirty-five feet high, and my longest poles were only eighty-six feet. There was no derrick on the scene, so it was up to me to think of a way to put the stack into position. The plan I finally hit upon was the simplest in the world. One pole was erected on one side of the cement base on which the stack was to stand, and a second pole on the other side. Then, just as a circus tent pole is made fast with ropes and stays, the two were fastened.

"NEXT we hauled the stack so that it lay between the poles, and dropped a block and tackle from the top of each one. A strong rope was wound around the stack several times, a little nearer its top than its foot, and the blocks from the tops of the poles hooked to this rope.

"The winches pulled, and the stack rose, top end first, while the base slid along the ground on a runway. At last, when the stack was upright, with its bottom over the cement base, all we had to do was to let it down a few inches and bolt it in place.

The main idea was the fastening of the blocks just above the middle of the stack. That made the stack right itself. Also, it made it unnecesary, except at the very last minute, to lift the full weight of the piece."

Because the rigger has to do all sorts of jobs, he learns all kinds of tricks to make the jobs easier. A nickel cake of soap can be his best friend at times.

"ONE of these times," said Doughty, "was when we unloaded a hundred-thousand-pound slab of granite from a freight car. The slab was for the roof of a mausoleum in Brooklyn. It had to be slid onto the truck that was to haul it to the cemetery, and it was in the sliding that the five-cent cake of soap played a part. First the stone was jacked up. Then beams, greased with the soap, were laid as a runway under the slab from the car to the truck. Next, planks of hardwood were soaped and placed against the greased beams. The slab was lowered onto the planks, and the jacks shot it out—maybe not as fast as greased lightning, but plenty fast enough!"

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When All Things Are Possible

(Continued from page 42)

director of the New York Zoological Society, to get specimens of deep-sea life. In his book, *The Arcturus Adventure*, Mr. Beebe describes his experiences.

Among the amazing devices on this remarkable ship there were a "bow pulpit" and a "boom walk" or sort of permanent gangplank extending from the port side; and there were all sorts of nets to snare the strange dwellers in the waters beneath, and dredges to scour the ocean bottom.

BEEBE describes the "pulpit" as follows:

"On every sea trip I have ever taken, my favorite position is as far out on the bow as possible, looking enviously down at the floating creatures which are constantly passing. And now I had devised this pulpit which answered every requirement. It is a bit of iron grating surrounded by a waist-high iron rail and fastened astride the bow of the *Arcturus*. It can be raised or lowered to any position."

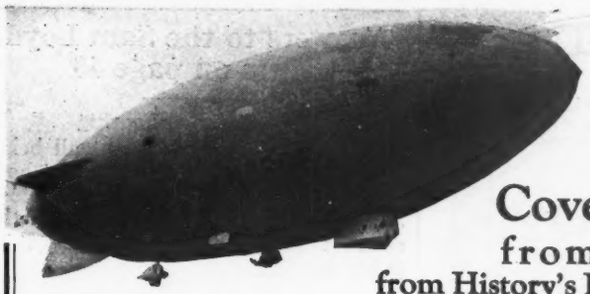
The "boom walk," a startling innovation, was suggested to him, Beebe said, by seeing a drawing of a pirate's captive walking the plank. It was made by rigging outboard on the port side two thirty-foot booms, one slightly above the other, and about three feet apart. To these a duckboard walk was laced. When this contrivance was swung at right angles to the vessel's side, it formed a runway extending beyond the wave thrown up by the *Arcturus*.

Trailing silk surface nets from the end, the scientists trolled for and harpooned dolphin fish and sharks. At dusk two clusters of electric lights were focused on a twenty-foot circle of water which drew a fascinating concentration of ocean life.

In his book Beebe describes the nets:

"FIRST there was paid out the otter trawl, a great bag of netting forty feet in length, with its gaping mouth held wide open by the oblique pull of two iron-bound boards. Then, at intervals of fifty fathoms, meter nets were lowered, each twenty feet long, made of the finest, most costly silk, with a mouth composed of a brass ring a yard in diameter. Five of these nets were attached to the steel cable by guide ropes, and they trailed straight out behind at various depths as the ship steamed at slowest speed through the water. For three hours they were pulled gently along at 500, 450, 400, 350 and 300 fathoms depth, blindly, uncontrollably but usually successfully engulfing the weird beings which happened to float along in their path."

By all these means the *Arcturus* adventurers brought up deep-water fish of all manner of strangeness, misshapen, translucent, some with great heads and no bodies, some with strange protruding spines, some even equipped with lights in rows along their sides or at the ends of tentacles! One dolphin had to be pinned to the deck after a wrestling match with the adventurous fishermen.



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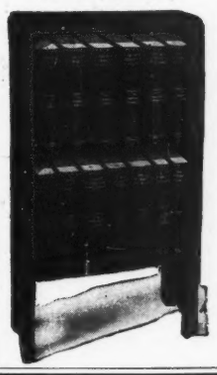

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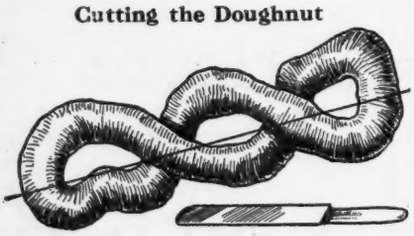
Answers to the Sam Loyd Tests on page 43

Mental Sharpshooting

The numbers on the target all being divisible by 6, the total score must be a multiple of 6 as well as of 17. Six shots—30, 30, 12, 12, 12, 6—total 102, is the smallest possible score to average 17 points to the shot.

Cutting the Doughnut

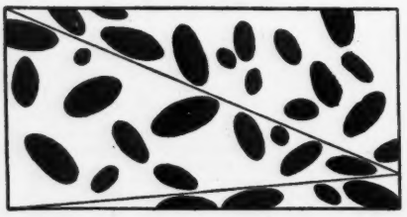


The diagram shows how the doughnut is made to produce seven pieces from one straight cut. True, the seventh piece is no more than that little bump which obtrudes across the line. It's a piece, nevertheless, and must be included in the total.

The Cats and Kittens

To make the two weighings alike, we have but to substitute a cat for a kitten on the lower scales. This change calls for an additional four pounds on the weight side. Thus we learn that a cat's weight exceeds a kitten's by four pounds. Substitute three cats for three kittens on the upper scales, at the same time adding twelve pounds to the other side to preserve the balance, and we have seven cats balancing against forty-nine pounds. Thus it is proved that a cat weighs seven pounds and a kitten three.

Through the Reefs



The diagram illustrates the two-stroke route across the reefs zone.

Building a Sentence

By interlarding the line with the letter M it is made to read: MAD MEN MIMIC AND MOCK

The "Resolutions"

1. Be wise. 2. Be on hand. 3. Be backward in naught. 4. Be honest. 5. Be benign. 6. Be independent. 7. Be behindhand in naught. 8. Be studious.

A DAY or so ago we showed Sam Loyd a brand-new game which has just been discovered and which will be introduced next month to the readers of POPULAR SCIENCE MONTHLY.

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Here Are Correct Answers to Questions on Page 52

1. When an athlete starts to exert himself, the sudden demand for more oxygen to take care of the increased work performed by the muscles causes a speeding up of the heart action. "Second wind" begins when the increased action of the heart and lungs reaches the point where the supply of oxygen just equals the consumption.

2. Nearly every muscle in the body receives a slight impulse during a sneeze—over fifty muscles in all.

3. The tiny nerves of sight that make up the retina of the eye are far more numerous than the grains of silver that make up the image in the ordinary photographic film. The lens of the camera transmits the fine detail to the plate in the same way that the lens of the eye transmits the detail to the retina. The difference in results lies in the recording device and not in the lens.

4. Some kinds of wood are more dense than others, being so heavy that they weigh more than the water displaced and consequently they sink.

5. It is possible to see a rifle bullet while it is actually traveling through the air by using a telescope placed parallel with and close to the barrel of the rifle. While the bullet travels thousands of feet a second in a direction away from the muzzle, its falling motion is no faster than any other falling body, and against a white background the bullet can be seen for a small fraction of a second.

6. Music is made up of vibrations of frequencies ranging from about 20 a second up to 30,000 a second. Only the best grades of radio loudspeakers are capable of approximating uniform reproduction of this wide range of frequencies.

7. While nickel itself turns into nickel oxide only at an extremely slow rate, the coating of nickel is rarely absolutely perfect. Wherever there is the slightest flaw, the iron surface underneath the nickel coating rusts and makes it peel off.

8. Water boils at 212° at sea level. On the top of a high mountain, the atmospheric pressure is lower and water boils at a lower temperature so that it takes longer to cook the egg.

9. The flame of a gas stove is blue because sufficient air is mixed with the gas to give complete combustion. An ordinary gas jet produces a bright yellow flame because the fine particles of carbon are heated to incandescence before sufficient oxygen from the air reaches them to cause complete combustion.

10. When an automobile goes around a corner, the outside rear wheel rotates faster than the inside one. The differential gear permits power to be applied to both rear wheels even when one is turning faster than the other.

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